THURSDAY, JANUARY 8, 1885

SCIENCE AND SURGERY

FROM the earliest ages, the functions of the brain have been a fascinating study to cultivated minds, and the greatest intellects of all ages have occupied themselves in attempting to solve its difficult and complicated problems. With the ancients this was a favourite pursuit, and engrossed the thoughts and talents of their most illustrious philosophers. Owing to the absence of exact methods of scientific observation and experiment, the conclusions on this subject were for many centuries of a purely speculative character, and the errors and fallacies thus deduced have been handed down and accepted till comparatively recent times. Modern investigations have, however, thrown a flood of light on the question, and although much still remains in the dark, the former obscurity has of late years been brightly illumined by the lamp of science. The accumulated clinical experience of ages had left knowledge on the cerebral functions in a state of confusion and uncertainty, and owing to the obvious difficulties and complications associated with disease, the results, however significant, were at best imperfect. That the brain should be subjected to direct physiological experiment was, until modern times, never attempted. During the last generation only has the practicability of this been demonstrated, and numerous observers have, by direct operations on the brain substance of animals, arrived at new conclusions as to its functions, and greatly revolutionised our ancient conceptions on the subject. Evidence has also been given against the *noli me tangere* theory, and abundant proof has been adduced of the fact that the brain may be handled, irritated, or partially destroyed without necessary danger to life. One of the latest developments of this method of investigation has been the discovery of those centres in the cortex which preside over voluntary motion, which have been, more especially by Prof. Ferrier, differentiated and localised with great precision. This important knowledge has been arrived at by an extended series of experiments conducted on living animals, in which, by observing the several effects of stimulating or destroying limited areas of their brains, the different functions of these special localities have been determined. A topography of the cerebrum has thus been constructed, in which the various faculties have been mapped out, but these, unlike the illogical visions of the phrenologists, have stood the test of sceptical criticism and rigid experimental inquiry. Researches of a purely scientific nature, carried out only with the object of elucidating truth and advancing knowledge, without immediate prospects of material gain, have in this instance led to most important and useful practical advantage. Armed with the knowledge acquired on animals in the laboratory, the physician has been enabled to utilise at the bedside the conclusions thus arrived at for the service of human beings. Clinical experience combined with morbid anatomy had already enabled the medical man to suspect the presence of disease in the brain, but as to its precise locality he was formerly in doubt. Now, however, guided by the recent revelations of physiology, he is enabled to predict the position in a large number of cases with great certainty and precision. Evidence of this is afforded by the proceeding adopted in a case of disease, notice of which has lately appeared in the medical papers. It appears that a man presented a series of symptoms which enabled Dr. Hughes Bennett to diagnose a tumour of the brain, that it involved its cortical substance, that it was probably of limited size, and that it was situated at a certain definite spot. The skull was trephined over the suspected region; there a tumour was found and removed. On recovering from the immediate effects of the operation the patien was and continued for three weeks in a satisfactory condition. He was perfectly intelligent, his functions, except for certain defects of motion caused by the disease, were normally performed, and there was an absence of all the distressing symptoms from which he had formerly suffered and from which he must necessarily soon have succumbed. Unfortunately, at the end of this time a complication, incident to all serious surgical operations, supervened, from which the patient ultimately died. The unhappy termination of this particular case does not in any way detract from the importance of the principles which it involves. It still remains a signal triumph of diagnostic accuracy, a precision mainly attained by exact experimental research. It is, moreover, further proof that by utilising this improved knowledge the surgeon may not only remove disease from the brain, but that he may do so without necessary shock or risk to the nervous system, and that the procedure, under modern antiseptic precautions, need not be attended with greater danger than may follow any other severe surgical injury. This interesting and instructive case will doubtless inaugurate a new era in medical practice, for although this particular individual has succumbed to measures adopted to avert his otherwise certain death, the experience thereby gained is sufficient to encourage further efforts in a similar direction which may prove beneficial to others. In the Marshall Hall oration of last year Prof. Ferrier remarked, "There are already signs that we are within measurable distance of the successful treatment by surgery of some of the most distressing and otherwise hopeless forms of intercranial disease, which will vie with the splendid achievements of abdominal surgery." He further added, reflecting on the success which had attended brain operations on animals, "I cannot but believe that similar results are capable of being achieved on man himself." That distinguished physiologist cannot but feel gratified that his prophetic words have been partially realised.

DE BARY'S "VEGETATIVE ORGANS OF THE PHANEROGAMS AND FERNS"

Comparative Anatomy of the Vegetative Organs of the Phanerogams and Ferns. By A. De Bary. Translated by F. O. Bower and D. H. Scott. (Oxford: Clarendon Press, 1884.)

IN 1861 a plan was drawn up in Germany to provide a series of hand-books or text-books on botany, which should treat of the science as it existed at the time; four of these books were completed, De Bary's "Vergleichende Anatomie der Vegetations-organe der Phanerogamen und Farne" (published in 1877) being one of them. This

book, as is well known, proved to be a masterpiece of industrious research, accurate treatment of facts, and critical sifting of details; its influence soon became apparent, not only on the best teaching and text-books of our time, but also on those engaged in original research in various directions. This marked influence was not confined to Germany, but affected the teaching in this country also; and some of us were so fortunate as to come under that influence before more antiquated methods of treatment had rendered difficult the task of receiving the new impressions.

Mr. Bower and Dr. Scott have now prepared a translation of this treatise, and those best acquainted with the original will be foremost in congratulating them, not only for having placed the work in the hands of English workers and students, but also for the manner in which it has been accomplished.

In commenting upon the plan of the book, it should be borne in mind that the basis of classification is anatomy, and anatomy only, and this accounts for many peculiarities in the mode of treatment.

The introduction sets this forth clearly, and shows the kind of difficulties to be avoided in the scheme. Students will gain by carefully reading this able introductory portion, which contains an admirable account and criticism of the relations of the tissues to the meristem from which they are derived, and the vexed question as to the best mode of classifying the systems of tissue in mature parts. The great difficulty of course is in the case of what Sachs terms the "fundamental tissue"—*i.e.* the tissue which remains after the dermal tissue and fibro-vascular system have been removed. De Bary finds it necessary to cut this up into several forms and systems of tissues, as was to be expected from the mode of treatment. Sachs has lately again maintained that on the whole the "fundamental tissue" is best regarded as one system. This and other discussions as to the relative value of systems of tissues certainly owe much to the point of view started from, and it is not easy to see how De Bary could avoid the further dissection of the larger systems of tissues.

As matter of fact he is constrained to adopt six chief forms of tissue, various groupings of which constitute the systems of tissues. These are: (1) Cellular tissue (epidermis, cork, and parenchyma); (2) sclerenchyma; (3) secretory structures; (4) vessels (this word is *Tracheæ* in the German, and "vessels" does not express its intended meaning accurately); (5) sieve-tubes; (6) milk-tubes (*i.e.* laticiferous vessels). Intercellular spaces forming the subject of an appendix. This preliminary classification, as would be expected, presents difficulties here and there, and it will be seen that the structures designated "secretory" afford exercise for the utmost ingenuity in classifying them anatomically.

Having laid down the lines along which the plan of the work is to run, so far as these forms of tissue are concerned, De Bary then proceeds to review and criticise the views held as to the differentiation of the various groups of tissues from definite layers or portions of the meristem of the growing-point. Hanstein's classification into dermatogen, plerome, and periblem is well known, as is also the calyptrogen of Janczewski. We cannot here enter into details, but must refer the student to this excellent summary, merely stating that the facts do not allow of Hanstein's classification being extended to all the cases, though it must be admitted as true for very many. Nor have later investigators succeeded in establishing a system of classification of the tissues comparable to that of the animal embryologist. This of course complicates the matter, and accounts in part for the plan followed in the second part of the book, which treats of the arrangements of the forms of tissue referred to above, and of the changes in their primary arrangement brought about by secondary changes, *e.g.* growth in thickness, &c.

In Part I. the first chapter deals with cellular tissue, the portion concerned with the epidermis and its structure being particularly interesting and important. De Bary's account of the stomata has long been known, but many facts relating to those peculiar forms known as water-pores or water-stomata will be new to the student unacquainted with the original. The description of the cuticle and cuticularised layers of the outer walls of the epidermal cells, and the facts as to the occurrence of wax on their exterior are very important, and must afford the basis for all future work on these subjects. A striking example of De Bary's critical power and ability to deal broadly as well as in detail with large series of facts are evident in his remarks on those troublesome organs known as glands. It may well be doubted whether we shall ever have a satisfactory classification of the various "secretory structures" on anatomical grounds solely; it must be admitted, however, that the most satisfactory account of these bodies, as a whole, is given in the present book. De Bary limits the term gland to epidermal secretory organs—all others are to have definite names implying their different position, &c. This necessitates the separate treatment of reservoirs of secretions, and laticiferous vessels as contrasted with epidermal or dermal glands on the one hand, and intercellular spaces which contain secretions, &c., on the other; the difficulties arising from various causes are in part met and discussed, but there are some still outstanding.

Having treated of the forms of tissue in the first seven chapters, Part II. of the book commences with Chap. VIII. The first section (Chaps. VIII. to XIII.) is concerned with the primary arrangement of the forms of tissue. The vascular bundles are here dealt with in great detail from two points of view: (1) with reference to their course or distribution in the stems, leaves, and roots; and (2) as regards their structure. The first aspect of vascular bundles is almost unknown in England, and most teachers have ignored it altogether. It is important, however, and although they must not be ranked or compared with structures occurring in other organisms, we must not forget that the supporting and conducting systems of a higher plant are represented by its wood and tracheæ, while its sieve-tubes have equally important duties to perform. This being so, there is no less reason for studying the course and distribution of the vascular bundles (and the same remark applies to laticiferous vessels, reservoirs of secretion, and even strands of sclerenchyma) in a plant, than for tracing the distribution of the various conducting, supporting, and secreting tissues and organs in a higher animal. Already the investigations promise to bear fruit, as witness Koch's descriptions of the course and endings of sieve-tubes in the leaves, and also the various points of anatomy which throw light on

the discussion as to the ascent of water in wood. No doubt it is too early to anticipate where these researches may lead; meanwhile every botanical student should learn the course of the vascular bundles in several typical plants, say, among others, *Lathyrus*, *Clematis*, a Palm, *Tradescantia*, a Fern such as *Aspidium*, and *Equisetum*. This should be done not only with reference to the distribution of these important structures, but also in order that the study of transverse sections may become something more than the impression of a pattern on the memory, as it too often is.

The bearing of these matters on the older views which confined the attention too much to the typical palm-type for the Monocotyledons, and to a few restricted examples of Dicotyledonous stems is obvious.

Some very important points exist also with reference to the structure of the vascular bundles, a matter which should be studied as De Bary studied it, in connection with the above. Students are seldom led to understand that the terminations and interconnections of vascular bundles often differ considerably from the enlarged portions of the bundles, or "bundle-trunks," as the translators term them. The classification of vascular bundles into collateral, concentric, and radial has become better known of late years; but even now too little attention is paid to the subject of the structure and development of the vascular-bundle system in roots. This should be all altered now, for it is difficult to imagine better guidance for teachers and students than is afforded by the work under review, and specialists will not be able to dispense with it.

Want of space prevents our entering further into some other weighty matters in this portion of the work. No doubt some difficulty will be felt by the uninitiated with regard to De Bary's treatment of the subject of sclerenchyma. The key to the difficulties consists in the fact that however convenient it may be to regard the sclerenchymatous fibres of the "hard-bast" as part of the "fibro-vascular" bundle, sclerenchyma may be regarded as a form of strengthening tissue which recurs in various positions, and may therefore be treated separately—that which occurs as strengthening tissue associated with the vascular bundles being called bast-fibres, and treated as part of the bundle (which then becomes "fibro-vascular") for no other reason than because it is convenient, and the name is an established one. Simple as the matter is when understood on anatomical grounds, we fear that confusion will still ensue from want of care in apprehending the state of the case; this will be due to no fault on the part of the translators, however, for the portions of the book dealing with these particulars leave little to be desired.

The second section of Part II., treating of the secondary changes produced in the arrangement of the tissues by growth in thickness, forms a part of the book which has had much influence on text-books since it was written. The account of the growth in thickness by means of a cambium zone is excellent, and should be carefully studied by every botanist. The concluding portions of the book are in some respects more adapted for the specialist than for the ordinary student, but we do not advise the latter to neglect them on that account; on the contrary, much of the foregoing information becomes clearer when contrasted with the more abnormal processes observed in the forms there treated of. The facts are somewhat more isolated, however, and can only become important in proportion as the earlier parts of the book are understood; moreover, work remains to be done among the more anomalous forms.

Enough has been written to show that no botanist will be able to dispense with the work, and it only remains to point out one or two faults in the translation, and perhaps to mention a few trivial matters which might have been put better. Such phrases as "a numerous group of large . . . cells (p. 21), "the morphologically lower leaf-surface" (p. 319), and "quite a few rows" (p. 372), are somewhat harsh, and result from the close rendering of the original; objection may also be taken to such employment of compounds as "air-and-water-containing" (p. 210) and "many-layered, chlorophyll-containing parenchyma" (p. 226). It is true that students of science who read much German find less difficulty from the recurrence of such forms in English than might be expected, but many will regard them as serious blemishes which render the book more difficult to read. *Commelyna* (p. 40) becomes "*Commelina*," subsequently (p. 270 *e.g.*) we believe the former is correct, the latter being the German spelling. "Equiseta" and "Gramina" (*e.g.* p. 213), and "*Orobanches*" (p. 384) are not elegant. The reference to Fig. 207 on p. 467 is wrong, that figure concerning *Cytisus*. No doubt the misprint stands for 209.

The translators are responsible for several terms which will be new to English botany, and we must admit our indebtedness to them for attempting to introduce definite English equivalents for such terms as "*Bündel-stämme*," "*Holz-stränge*," "*Neben-zellen*," and "*Ersatz-faserzellen*." Whether "bundle-trunks," "ligneous bundles," "subsidiary cells," and "intermediate cells" respectively will be generally accepted as the equivalents in English remains to be seen. Personally we regard them with favour, as serviceable representatives of terms which have their uses. However, we can do no more here than congratulate the translators on having placed one of the most important scientific works of the day in the hands of British botanists in a satisfactory form; and we no less heartily congratulate those botanists who have been debarred from reading it in the original German on the rich store so well placed before them.

OUR BOOK SHELF

The Solar System. By Ernest R. G. Groth, M.D. Pp. 34. (London: John Bale and Sons, 1884.)

THIS book contains a very imperfect account of the nebular hypothesis of Laplace and Kant, with certain variations which must be incorrect, because they violate mechanical principles, and with certain speculations which are valueless because they are based on mere imagination.

The author does not realise the relativity of force and motion, for on p. 9 he asks: "If a body be acted upon by no force, why should it move at all?"

On p. 11 we learn how axial rotation originates when a nebular mass revolves orbitally about a centre of force. The explanation depends on the different orbital motion of the nearer and further parts of the nebular planet. As far as this goes it should, when properly applied, give us

negative rotation in the planetary mass, but we here find it used to explain positive rotation.

The author states that the planets are "hurled" or "projected" from the sun; but he does not see that even if some *deus ex machinâ* were just to prevent the otherwise inevitable fall back into the sun, the eccentricity of the orbit must be very large instead of very small.

On p. 14 we find that "it is moreover manifest that each individual planet must from time to time have had its orbit greatly extended" by the reduction of the sun's mass on the birth of each planet. It is, however, the fact that the orbit of Jupiter, for example, would be scarcely appreciably altered were this process reversed, and were all the planets interior to Jupiter either suddenly incorporated with the sun or annihilated.

On this same page we learn "that in a system of particles revolving about a fixed centre, the momentum, that is the sum of the *products of the mass of each into its angular velocity* (sic ital), and the distance from the common centre is a constant quantity." Does it not follow that when a planet moves in an elliptic orbit, so that its distance from the centre of force is *not* constant, there is *not* constant moment of momentum? What then becomes of the generally accepted conservation of areas in elliptic motion?

The fanciful explanation of the inclinations of the planetary orbits, and of the obliquity of the planetary axes, need not be stated; but we observe that "the northern hemisphere, being that which contains more land than the southern, was directed away from the sun at the time it (the earth) was projected away from that body," and this, together with the context, shows that the northern hemisphere is here supposed to be heavier than the southern. The fact of course is that the hemisphere antipodal to Spain, by its greater density, attracts the sea away from the Spanish hemisphere and leaves our half of the globe drier than the other half.

The asteroids arise from the rupture of a planet X, which in cooling had been converted into a vast Rupert's drop (p. 21): "What a scratch does for the Rupert's drop, the pull occasioned by Jupiter's attraction effects for the doomed planet: the thin crust is rent, and forth in a thousand different directions fly his meteoric fragments."

On p. 23 we find that the Glacial period was a sudden catastrophe, and that the fleeing mammoths were caught by the intense cold and frozen to death.

At the end of the work the author emphasises the analogy, long ago pointed out, between the system of Saturn and his satellites and of the sun and his planets.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Apospory in Ferns

MY note in NATURE (p. 151) on the remarkable mode of reproduction in ferns discovered by Mr. Druery has brought me two friendly communications, both of which deserve a few words.

Dr. Vines reminds me that in an article on the proembryo of *Chara*, published in the *Journal of Botany* (1878, pp. 355–363), he had suggested that this structure is homologous with the spore-bearing generation (sporophore) in mosses. His arguments in favour of this view are extremely ingenious, if not wholly convincing. At any rate, if his theory is correct, the sporophore in this plant remains in a rudimentary condition, "producing no spores, but giving rise to the oophore by the lateral budding from one of its cells." Hence, he concludes, "we may speak of this plant as 'aposporous,' using a word which is symmetrical with the term 'apogamous,' applied by De Bary to those ferns in whose life-history no process of sexual reproduction occurs." We must give Dr. Vines, I think, the credit for first clearly defining in terms the aposporous condition as the converse of apogamy, though the phenomenon was first observed by Pringsheim in the Moss in 1876 (*Monatsb. d. Königl. Akad. der Wiss. zu Berlin*, 10 Juli, 1876). At any rate, according to Dr. Vines's view, what is only an occasional abnormality in the moss and the fern is the normal state of things in *Chara*.

The distinguished Italian botanist and traveller, Signor Odoardo Beccari, points out to me that the structures now known as archegonia and antheridia had been observed in *Salvinia natans* as early as 1834 by Savi. I had not overlooked the paper in which priority for the discovery was claimed for Savi by Marcucci (*Nuovo Giorn. Bot. It.* i. pp. 198–208). But the brief chronological table which I gave in my note had reference only to ferns proper (*Filices*) and not to the heterosporous group of the *Filicinæ*—the *Rhizocarpeæ*.

W. T. THISELTON DYER

Frost Formation on Dartmoor

ON the afternoon of Tuesday, December 30, 1884, about 3 p.m., we were on Yes Tor, near Okehampton, long reputed the highest point of Dartmoor, though it is understood that the new survey now in progress brings out the neighbouring summit of High Willhayse a few feet higher. For about 200 feet below the Tor the ground was frozen hard. It was free from snow, the weather having been fine for several days, but everything was white with hoar-frost. On the rocks of the Tor this frost assumed a form of singular beauty, and, we think, not a common one. At least, neither of us can match it in either English or Alpine experience, or remember to have seen an account of anything like it.

On the first impression the walls of the granite masses which make up the Tor looked as if covered with feather-work exquisitely wrought in congealed snow. The feathers (to call them so provisionally) overlaid one another as thickly as real plumage, and ranged in length from one inch or less to five or six inches, being smaller on the flat and recessed surfaces of the rock, and larger on the jutting and exposed ones. They lay almost wholly on the eastward, that is (as the weather then was, and for some days had been) the windward side of the Tor; and their tips pointed roughly in that direction, with the sort of uniformity one would get by laying down a great number of branches or feathers all one way. It is impossible to describe the richness of this natural decoration. Only the finest Oriental workmanship could come near the effect produced by the infinite and minute variety which this tapestry of frost-flakes combined with one dominant form and direction. Something of the same type, but far less perfect, may be seen on a mussel-covered rock at low water. Still more curious was the appearance of the Royal Artillery flagstaff which surmounts the Tor. It was loaded (on the windward side, like the rocks) with a solid fringe of the same formation, but in longer and thicker flakes. We judged it to be full six inches deep, and at first thought it must be supported by a string attached to the staff, but there was, in fact, no string at all.

Close examination of the individual flakes revealed great beauty of structure. They were mostly of an elongated lozenge shape, like a squared spear-head, but sometimes more like tongues of flame. Their contours and delicate surface-markings showed them to be built up of laminæ, into which they were easily resolved by a slight blow. These laminæ again split up into crystalline needles parallel to the longer diameter of the flake, that is, in the line of the imaginary spear-shaft. Only photography or very careful drawing (for neither of which had we the means, time, or skill) would clearly convey the details of the formation.

As to the physical explanation, we conceive that the process must have been set up by a thin layer of mist (probably in a very finely-divided state to begin with) drifting against the rock and freezing to it. Successive accretions brought in the same way would gradually produce the display of giant hoar-frost which we have imperfectly described. The details of form and structure we leave to be considered by those who have made a special study of ice-crystals. But it seems fairly obvious that for such a result there must be a concurrence of many favouring conditions. There must be a clear frost without snow, which of

course would destroy and obliterate these delicate forms. There must be a steady set of wind, enough and not too much of it, and the air must be saturated with moisture in a certain state of molecular division. Some of these data might, perhaps, with the resources of a modern laboratory, be settled by experiment. If the experiment succeeded it would be an extremely pretty one.

F. POLLOCK
C. C. COLLIER

Woodtown, Harabridge, South Devon, January 2

Krukenberg's Chromatological Speculations

MY attention has been lately called to a recent publication of Dr. C. F. W. Krukenberg, entitled "Grundzüge einer Vergleichenden Physiologie der Farbstoffe und der Farben," in which some remarks and misstatements occur relative to my work, which in self-defence I feel I am not justified in letting pass without comment.[1]

(1) With regard to his observations on the colouring matter obtained by me from the integument of certain invertebrates, and which I called "*dermochrome*," I do not see why I should have left it unpublished because three-quarters of a year before he had found that "lipochromes" were widely distributed in the animal kingdom. I found that lutein and hæmatoporphyrin occurred together in a peculiar combination, and said so. I suppose the offence lies in the name "lutein." This word must now, according to Krukenberg, be got rid of, because he has chosen to call it "lipochrome." Perhaps, after all, "lutein" is more appropriate, as it does not mean fat pigment; for this pigment occurs where there is no fat, *e.g.* it is not derived from fat in the *Corpora lutea*. Krukenberg bases his conclusions mainly on the reactions of the solid pigment with nitric and sulphuric acid and iodine, but I hope to have something to say on this point before long.

(2) Krukenberg maintains that the chlorophyll of cantharides is due to that in the intestines of these beetles. He committed himself to this theory at an early stage of his investigations, *before he knew of Pocklington's observations*; but after seeing the abstract of my paper read at the meeting of the British Association at Southport in 1883, in which I called attention to Pocklington's work, he makes it appear that he knew all about it long ago, which is not fair. Now since Pocklington and I obtained chlorophyll from the *elytræ* of these beetles, I do not think the above theory can be accepted, except it can be proved by Krukenberg that the intestine ramifies through the *elytræ*.

(3) Krukenberg says that *I "assume"* that the chlorophyll spectrum seen by me in the integument of the larva of *Pieris rapæ* is due to chlorophyll in that situation, whereas it is really due to chlorophyll-holding masses in the intestine. I never did "assume" anything of the sort. I said distinctly at Southport that it was due to food chlorophyll in the intestine, as could easily be proved, for on emptying the intestine the chlorophyll band could no longer be seen. This must be a wilful misrepresentation, as he acquired the knowledge of Pocklington's work from the same abstract in which my explanation occurs.

(4) He further says that my knowledge of the literature of the subject must be great when I assume that he has confused "*anthea green*" and "*diatom yellow*," whereas I said distinctly "it would appear, according to Geddes" (see Geddes' paper in NATURE, vol. xxv. p. 303) that he had confused them. I may, however, now observe that his supposition that the colouring matter of the yellow cells of *Anthea* is what he calls a "hepatochromate" can easily be disproved; all that is necessary is to add a little caustic potash or caustic soda to its alcoholic solution when the colouring matter becomes completely altered; for this reason any deductions drawn from Krukenberg's "saponification method" in this case are of little value.

(5) Krukenberg says he had found "chlorophyll-like stuffs" in the livers of animals before I had done so. I am sure this statement is open to question, as his spectra are not accurate representations of what is seen in solutions of *enterochlorophyll*. In most cases only one or two bands are shown by him, and the other proofs brought forward by me are not given in the accompanying text. If his own test for a true chlorophyll be accepted, I can, and hope shortly to, show that animal chlorophyll is a true chlorophyll, and can be obtained in the crystallised state, and the crystals are the same as those obtained by Dr. Hansen, an abstract of whose work will be found in this journal (vol. xxx. p. 224).

(6) It is further suggested that the darkening of the bands in solutions of "echinochrome" (a pigment whose spectrum I have lately described) produced by adding sulphide of ammonium, is caused by precipitation of certain ingredients. This is not the case. The same appearance is produced by stannous chloride and other reducing agents. I have, however, lately succeeded in isolating this pigment, and can confirm my former results. I hope to publish shortly an account of the spectra of its solutions.

(7) Krukenberg makes it appear that I have said that the green gland of the crayfish contains hæmoglobin. I never said so. The statement was this: "In the green gland of one crayfish a band was detected which, I think, was due to reduced *hæmatin*, but it was absent in the second specimen examined." Perhaps Krukenberg thinks that hæmoglobin and hæmatin are the same.

(8) I am made responsible for the statement that the eye of the house-fly contains hæmoglobin; I never said so, nor can I agree with Krukenberg that it gives no band. It gives a band at D, and is not similar to the pigment of the eye of Cephalopods, which he assumes to be the case.

I leave the inferences to be deduced from the above statements to others; but I must protest against Krukenberg's treatment of my work. It is at least satisfactory to know that my experience is not unique, as other English, German, French, and Italian workers receive an equally fair treatment by Dr. Krukenberg.

Wolverhampton, Dec. 23, 1884 C. A. MACMUNN

[1] The papers in which my observations on the subjects referred to were published are:—*Proc. Roy. Soc.*, 1883 (No. 226); *Proc. Birmingham Philos. Soc.*, vol. iii., 1883; and *Brit. Assoc. Reports*, 1883.

Our Future Clocks and Watches

I WOULD suggest, as a modification of "R. B.'s" suggestion in NATURE (p. 80), that the striking of the clocks on the twenty-four system might be varied at each quarter of the day, so as to indicate the time without so much striking. Thus, 1 (a.m.) to 6 might be indicated by the usual method; 7 could be indicated by two strokes, a pause, and one stroke; 8, by two strokes, a pause, and two strokes: and so on to 12; 13, by three strokes, a pause, and one stroke; and so on to 18; 19, by four strokes, a pause, and one stroke; and so on to 24, which being thus indicated by only ten strokes would require less effort to count, and make less noise than by the old system. Dials might be modified in the same way. Instead of twelve there would be only six divisions around the dial, and the quarter of the day could be indicated by a small wheel revolving behind a peep-hole, or by a third hand (which could be very short) revolving once a day over four divisions or quadrants, marked on the dial near the axis. People, however, would seldom or never need to look at this. Thus would be done away all the objections urged by Harmer. The hour-markings are only conventional signs any way, and it does not make any especial difference in what way the hours are indicated if people would only accustom themselves to the use of the twenty-four hour system in speaking and writing. H. H. CLAYTON

Ann Arbor, Michigan, December 20, 1884

MODE OF RECKONING TIME AMONGST VARIOUS PEOPLES

THE recent Prime Meridian Conference at Washington has attracted attention to the methods employed at various periods, and amongst peoples in different stages of civilisation, to reckon time. Dr. Robert Schram, on October 24, read an interesting paper on this subject before the Geographical Society of Vienna, in which he dealt chiefly with the Chinese, Hindoos, and the Jews. The three units of measurement given by Nature herself are the rotation of the earth on its own axis, the revolution of the moon in its orbit, and that of the earth around the sun; these are wholly independent of each other, and neither is an aliquot part of the others. But from the earliest times efforts have been made to connect these units; there is the attempt to balance all three, which gives the luni-solar year, or those to connect the day with the course of the sun or of the moon, from which we get the solar or lunar year. In the earliest times the most complicated of these, the luni-solar year, in which it

was sought to connect and equalise all three units, was the one most in use. This is comprehensible when we recollect that now we want to fix single days as far back or in the future, as we wish, and that therefore this form of year appears complicated to us; but in primitive times it was really the most simple form of all, for the sun and moon relieved man of the trouble of reckoning days, and in the months and seasons wrote large on the face of Nature herself the hours and minutes, if we regard the days as seconds. A glance at the heavens or at the surrounding vegetation must have told primitive man the most that he wanted to know of the passage of time, and have supplied the deficiencies of his calendar. How the luni-solar year came direct from Nature herself, and also how it was to be taken as an approximate method only, may be seen in the most ancient form of the Jewish year, which was so regulated that the feast of Passover should be celebrated when, during full moon the barley, which was required as an offering, was ripe, and it must be in the first month of the year, which was then Nišan. Twelve months then were counted from this; but if at the end there was no prospect that the barley would be ripe in fourteen days, a second month, Adar, was simply intercalated, and the new year began with the next new moon. But when an exact and rigid measurement of time is required, this form of year is simply perplexing. The three main types existing down to our own day of the luni-solar year are the Chinese, the Hindoo, and the Jewish years, and each of these is treated by Dr. Schram in turn.

With the Chinese, as in the case of almost every luni-solar year, every month begins with the new moon, and the first month is that in which the sun is in Pisces, the second that in the course of which it enters Aries, and so on. But if the sun in the course of a lunar month does not enter into a new zodiacal sign, it is regarded as an intercalary month, and receives the number of the previous month, with a mark of distinction. In this way months of 29 and 30 days succeed each other, but there is no fixed rule for this succession, nor for the place of the intercalary month of the year, nor for the succession of the intercalary years, and as the commencement of all the months and years have to be astronomically calculated, the whole year is somewhat uncertain and fluctuating, for a few minutes, or even seconds, may alter the beginning of a month by a day, and cause a difference in the intercalation of a month. It is difficult, too, to say according to what tables the astronomical data in the more ancient periods were calculated, so that it would be a matter of much uncertainty to transfer a date into another chronological system, if it were not for the circumstance that the Chinese from the most remote antiquity employed a cycle of 60 days for reckoning the days, much as we employ the week, without regard to the movements of the sun or moon. The uncertainty of the year which prevents the fixing of a precise day two or three years hence has rendered the calendar an indispensable *vade mecum*. The compilation of the calendar has thus become a work of vast importance, which the State has taken on itself and committed to the care of an Imperial mathematical tribunal, presided over by a royal prince. When the work is periodically completed it is presented with great pomp to the members of the Imperial family and to the members of the Government. The years are counted among themselves in two ways, employed simultaneously. The official year is the fourth, fifth, or as the case may be, of the reign of the Emperor, although even this is subject to alteration; while there is also a series of cycles of 60 years each, every individual year having a distinguishing name of its own. These years are named on a system universal in Eastern Asia, which is based on a combination of one name from ten *Kan* or "roots," with one from twelve Chi or "branches." This peculiar method of forming a cycle by the combination of two smaller cycles is found among the Japanese, Manchus, Mongols, and Thibetans, all of whom use the 60-year cycle formed from the cycles of 10 and 12 years; also among the Aztecs a cycle of 52 years, formed from one of 4 and 13 years, is found, which led Humboldt to believe in an infusion of Asiatic ideas in Mexico. The years are more rarely given in a 12-year cycle, each having the name of some animal; this is also universal in Eastern Asia.

The luni-solar year amongst the Hindoos was based on a sidereal solar year, the twelve months of which, though of unequal lengths, were of fixed duration down to the minutest fraction of time. Thus the solar month Chaitra was 30 days, 20 hours, 21 minutes, 2 seconds, and 36 thirds. The day, however, had 60, not 24 hours. The year began with the new moon immediately preceding the commencement of the solar year. But if two lunar months began in the same solar month, the first was intercalated. In case no lunar month fell in the solar month, then that year would lose one of its ordinary months, but at some other part of its course it would have two intercalary months. Every month among the Hindoos has its proper name. The new moons with which they commence are calculated with great exactness and according to inflexible rules, so that it is easier to go back than in the Chinese system. Still there is a difficulty, on account of the various systems employed at different early times. The fact, too, that the day is the thirtieth part of the lunar month, and thus shorter than the natural day, introduces an element of doubt into calculations of this nature. The years are reckoned from 0; the first year of the era is 0, the second 1, the third 2, and so on, so that the number given to any one year is that of the preceding one. The 60-year cycle is also employed, but it is not formed from the combination of two cycles; each year has its own name. It is based on the course of Jupiter and contains five revolutions of that planet; but as the twelfth part of a revolution of Jupiter is only 361 days, 1 hour, 36 minutes, while the sidereal year contains 365 days, 15 hours, 31 minutes, 31 seconds, 6/3rds, a new re-arrangement is from time to time necessary, and a year of the cycle has to be periodically omitted. There are three separate rules for calculating when this is to be done. As eras are employed by the Hindoos for reckoning years, the cycle is of less importance. These eras are themselves divided into cycles of varying lengths. The current era is the Kali Yuga, or Iron Age; 4985 years of it have already passed, so that it is little younger than the era of the creation; but according to Hindoo notions it has still a vast course to run, and it is an age of which not only the beginning but also the end is precisely known. It is to last in all 432,000 years, and the earlier periods run as follows:—

Kali Yuga, or Iron Age	432,000 years
Dvapara Yuga	864,000 ,,
Treta Yuga, or Silver Age	1,296,000 ,,
Krita Yuga, or Golden Age ...	1,728,000 ,,

These four form a so-called Maha Yuga, or Great Age, of 4,320,000 years. Of these Maha Yugas there are 71, giving 306,720,000 years, *plus* a twilight of 1,728,000, give 308,448,000 years, being the length of a patriarchate. There are fourteen of these patriarchates, or 4,318,272,000 years, which, with a dawn of 1,728,000 years, give 4,320,000,000 years, being a kalpa or æon of Hindoo chronology. But the ages extend beyond this, for an æon, or kalpa, is only one day of Brahma; his night is of the same length, and 360 such days and nights form a year of his life, which lasts 100 of these years. The present age is the Kali Yuga of the 28th Great Age of the 7th patriarchate of the first æon of the second half of the life of Brahma, who is therefore 155,521,972,848,985 years old at present. But Brahma's whole life is only a wink of Siva's eye!

Another form of the luni-solar year is that of the Jews.

In its later and more developed form this does not rest on observation or on fluctuating astronomical calculations, but on a comparatively simple cycle, based on a fixed month and year. Everything is settled beforehand: the intercalary month and year are inserted at stated periods. The system is the nineteen-year metonic cycle: nineteen solar years give 235 lunar months, in the course of which the 3, 6, 8, 11, 14, 17, and 19th years are intercalary, a month being inserted between Adar and Nisan. The months are successively 29 and 30 days long, the times of each being settled. But simple as this appears, various circumstances have conspired to render Jewish chronology very complicated. Such are the inclusion of small fractions of time in calculating the new moon for the new year, and the frequent religious precepts dislocating the arrangement for the beginning of the year; so that there are years of 353, 354, 355, as well as those of 383, 384, and 385 days. The years were reckoned regularly from the creation of the world, which is placed on October 7, 3761 B.C.

Having thus discussed the forms of the luni-solar year still in existence, Dr. Schram refers to those formerly in use by various nations. The Greeks also employed the cycle of nineteen lunar years, with seven intercalary months in every cycle, thus approximating to nineteen solar years. The months were of 29 and 30 days, and the years were reckoned by Olympiads of four years each. Subsequently Calippus brought the metonic cycle closer to solar periods by the omission of one day in every 76 years.

Among many peoples the modes of reckoning time do not deserve the name of a system. The Otaheitans used the changes of the moon, and the growth of the bread-fruit; the Makha Indians on Cape Flattery the moon, and the seasons, of which latter they distinguished two, the cold and the warm; the Muysca Indians, according to Humboldt, had 37 lunar months in their cycle, and 20 of these cycles formed a larger one. Where there were no religious festivals connected with the new or the full moon, people gave up the luni-solar year altogether, and adopted the solar year only, confining themselves to bringing day and night into connection with it as far as possible, and paying no regard to the moon's course. It was soon found that the solar year was approximately 365 days in length, and this we find first in the year of the ancient Egyptians. They divided their solar year of 365 days into 12 months, each of 30 days, to which they added 5 supplementary days. The years were counted according to the reigns, and the Canon of Ptolemy is a chronological table giving the commencing years of the various kings. The same form of year is found amongst the Persians, with the difference that the supplementary days were added to the 8th and not to the 12th month. Their months had names, not numbers, and their years were reckoned from the accession of Jezdegird, an era from which the Persians, especially in some parts of India, still count their years. It is remarkable that so inexact a year, originating so long ago, should have existed through centuries down to our own day, although its incorrectness was early recognised. The Egyptians, for whom the time of the rising of the Nile, at the ascent of Sirius, was of great importance, noticed soon that the occurrence came later and later in their year, and that if the Dog-star rose one year on New Year's Day, four years later it was the second day, eight years the third, and so on. On this they based the Sothis, or Dog-star period of 1461 Egyptian years, in the course of which Sirius rose successively on every day of the year. Then came the knowledge of the year of $365\frac{1}{4}$ days, which is tolerably exact, and of this there are several forms of years. In Egypt the change to the more exact reckoning was accomplished in a simple way. The months of 30 days and their names were retained, but to three of them in succession 5 days were added, and every fourth year the supplementary day gave 6 days to 1 month. This form of year is called the Alexandrian, and it is used at present by the Copts in connection with the Diocletian era. This year of $365\frac{1}{4}$ days was carried to Rome by Cæsar, where the method of counting time was in disorder; and henceforth in Rome the year was of this length, the months consisting of different numbers of days, in place of the Alexandrian supplementary days. This system forms the foundation of our calendar, and is the well-known Julian reform. A peculiar form of the year of $365\frac{1}{4}$ days was that of the ancient Mexicans. Their solar year consisted of 18 months of 20 days each; at the end of the year 5 supplementary days were added, and at the end of 52 years, 13 more days. The old Icelandic year also was very peculiar. The unit there was the week of 7 days, and in order to make the year an exact number of weeks, there were 12 months of 30 days each, with only 4 supplementary days at the end. Then at the end of 6 or 7 years another week was added, so that the ordinary year consisted of exactly 52 weeks, while the leap year had just 53. The year of $365\frac{1}{4}$ days was, however, a little too long, and in about 128 years there was an error of 1 day. In the Julian as well as in the Alexandrian system an improvement was found. The former was reformed by Pope Gregory XIII., not so much in the form of the year, as in the method of intercalating. In every year divisible by 100 the intercalary day was to be omitted; but in those divisible by 400 it was to be introduced. Shah Shelal Eddin reformed the Alexandrian system by an ordinance that when the intercalation had taken place every fourth year for 7 or 8 times, the next time it should not take place till 5 years had elapsed. In other words every seventh or eighth leap year was to be the fifth, not the fourth year. Thus there would be 7 leap years in 29, or 8 in 33 years. The last attempt to reform the Alexandrian system was made during the French Revolution, partly with the object of introducing the decimal system into time reckoning, partly also to get rid of all reference to Christianity or any other form of confession. The year which was then introduced was based on the Alexandrian year, but the intercalation was different. The months, consisting of 30 days each, received the names of Vendémiaire, Brumaire, Frimaire, Nivose, &c., and were divided into 3 decades of 10 days each, which took to some extent the places of the weeks. The intercalation was not cyclical, but based on exact astronomical calculations, and it was decreed that the first Vendémiaire should commence with the day on which, according to exact Paris time, the sun entered the autumnal equinox. It is easy to see that this method of intercalating could not exist long without reform, even if there were no independent objections to it, for it has all the defects of the Chinese year. The years were counted from the proclamation of the Republic.

The lunar year is the last portion of his subject treated by Dr. Schram. All that can be said about it occupies but a small space. Here a balancing of the days and of the course of the moon alone is required, the movements of the sun, and the change of the seasons being wholly disregarded. The Turks and Arabs use this year, and indeed it is common all over the Mohammedan world. The year has 12 lunar months; but the Turkish year can hardly be called a year in our sense of the term, with its regular succession and return of the seasons. In the course of 33 years the beginning of this year ranges over the whole of the seasons. If a Turkish festival comes one year in the depth of winter, 16 years later it will be at midsummer. The 12 months have 30 and 29 days: in the leap year the last month has 30 instead of 29 days. In a cycle of 30 years, the leap years are the 2nd, 5th, 10th, 13th, 15th, 18th, 21st, 24th, 26th, and 29th years. The years are counted from the flight of Mohammed from Mecca to Medina.

THE LATE JOHN LAWRENCE SMITH

THE following information relative to Dr. John Lawrence Smith of Louisville, U.S.A., who died on October 12, 1883, in his sixty-fifth year, is abstracted from a sketch of his life and work, prepared by his friend, Prof. Silliman, at the request of the American Academy of Sciences.

John Lawrence Smith was born near Charleston, South Carolina, on December 17, 1818. "Even as a child of four years, and before he could read," says his friend, Dr. Marvin, "he was familiar with the operations of simple arithmetic; at eight he was prepared for the study of algebra, and at thirteen was studying the calculus." At the age of seventeen (1836) he entered the University of Virginia, and for two years devoted himself to the study of chemistry, natural philosophy, and civil engineering. For twelve months after leaving the Univeristy he acted as assistant engineer on the Charleston and Cincinnati railroad, but relinquished the post with a view to the study of medicine. While still a student in Charleston he made known to chemists (1839) the use of potassium chromate as a reagent for distinguishing between the salts of barium and strontium; and in the same year he published a paper on a new method of making permanent artificial magnets by galvanism.

In 1840 Mr. Smith proceeded to his medical degree, submitting as a graduation thesis an essay upon the compound nature of nitrogen. His father being a well-to-do merchant. Mr. Smith was able to continue his medical studies; for this purpose he travelled to Europe, and spent his winters at Paris under Dumas, Orfila, Pouillet, Despretz, Becquerel, Dufrénoy, and Elie de Beaumont, and his summers at Giessen under Liebig. In 1842 appeared his elaborate paper on "The Composition and Products of Distillation of Spermaceti," probably the first extensiue work in organic chemistry undertaken by an American chemist. In 1843 he began medical practice, though chemical research was more congenial to his taste; and, in fact, during the next four years, he found time to contribute important work towards the improvement of analytical methods in chemistry. At this time he also acted as assayer for the State of South Carolina, studying its marls, ores, and cotton-bearing soils. Able reports on these subjects led to his selection by the Secretary of the United States as professional adviser of the Sultan of Turkey in the matter of the introduction into that country of American methods for the culture of cotton. "Finding, on his arrival in Turkey, that an associate proposed to inaugurate the cultivation on a plan doomed to failure, he was about to return to America, when he received from the Turkish Government a commission to explore the mineral resources of the country. He entered at once, with his customary zeal and intelligence, upon the work, and in the four years of his residence in the Sultan's dominions, in spite of many vexatious restrictions, he opened up natural resources which have ever since added an important item to the revenues of the Porte. His memoir on emery (1850) was equally important, both from a scientific and economic stand-point. Before his observations 'On the Geology and Mineralogy of Emery,' made in Asia Minor, little was known of the mode of occurrence of this useful mineral. The island of Naxos had long been almost the only locality, and the supply from this source was limited and the price excessive, and no geologist had found an opportunity of studying the mineral associations of emery or its relations to corundum. Smith's sagacity as an observer, his originality in discussing new methods of examination, his patience and conscientious fidelity in executing his work, are all conspicuous to the student of this memoir. From the study of the mineralogical associations in which he found the emery of Asia Minor, he felt convinced that the search for like associations elsewhere would be rewarded by the discovery of emery or corundum. With this view he addressed Prof. Silliman, requesting him to test the correctness of his observations upon known localities of corundum in the United States. The associate minerals were immediately found and reported. Later on, Smith had the opportunity of seeing the accuracy of his views demonstrated at the emery mine of Chester, Hampden County, Massachusetts, which Dr. Charles T. Jackson had discovered by use of the key of its associate minerals, as suggested by Smith, the locality having been before regarded only as an iron mine."

Weary of the life he led in Turkey, and irritated by the obstacles thrown by the Turkish officials in the way of any real mineralogical exploration of the country, Dr. Smith resigned his appointment in 1850, and returned to America. He married in 1852, and in the same year succeeded to the chemical chair in the University of Virginia, which he retained for one year; it was at this time that he published the method of determining the alkalies in silicates which is now in general use. From 1854 to 1866 he was Professor of Chemistry at Louisville, but finding the restraints of a professorship distasteful, he, in the latter year, resigned the chair, and afterwards devoted his scientific work almost wholly towards the investigation of the chemical nature of meteorites, publishing nearly fifty papers on that subject. Having been successful in collecting illustrations of no less than 250 falls, he was very anxious that the collection should be kept together, and with this view he negotiated its sale for 2000*l*. to Harvard College; the news of the conclusion of the purchase only reached him on the last day of his life. Since his death the sum received from Harvard College has been presented by his widow to the American Academy of Sciences for the institution of a "J. Lawrence Smith medal for researches on meteoric bodies."

"Dr. Smith's personal character possessed a charm which won all who came within the sunshine of his genial nature. His sturdy manliness and integrity was combined with an almost feminine gentleness. During the years of the Civil War, while his affiliations and life-long associations were inseparably united with his native south, he deplored the sad conflict with a spirit bowed as under a personal sorrow; but none heard a word from him which partook of bitterness or animosity, and no shadow passed across the path of his old friendships."

Dr. Smith had no children, but he founded and amply endowed an orphan home in Louisville, his adopted city.

For the last two or three years he was in delicate health, owing to a chronic affection of the liver; and on August 1, 1883, a severe attack of the disease compelled him to take to his bed, from which he never rose again. Without acute suffering he passed peacefully away on Friday, October 12, at three in the afternoon.

By his direction, his funeral was of the most simple character and without an eulogy. His life closed as he had lived, peacefully, with uncomplaining endurance of suffering. His last words were: "Life has been very sweet to me; it comforts me. How I pity those to whom memory brings no pleasure!"

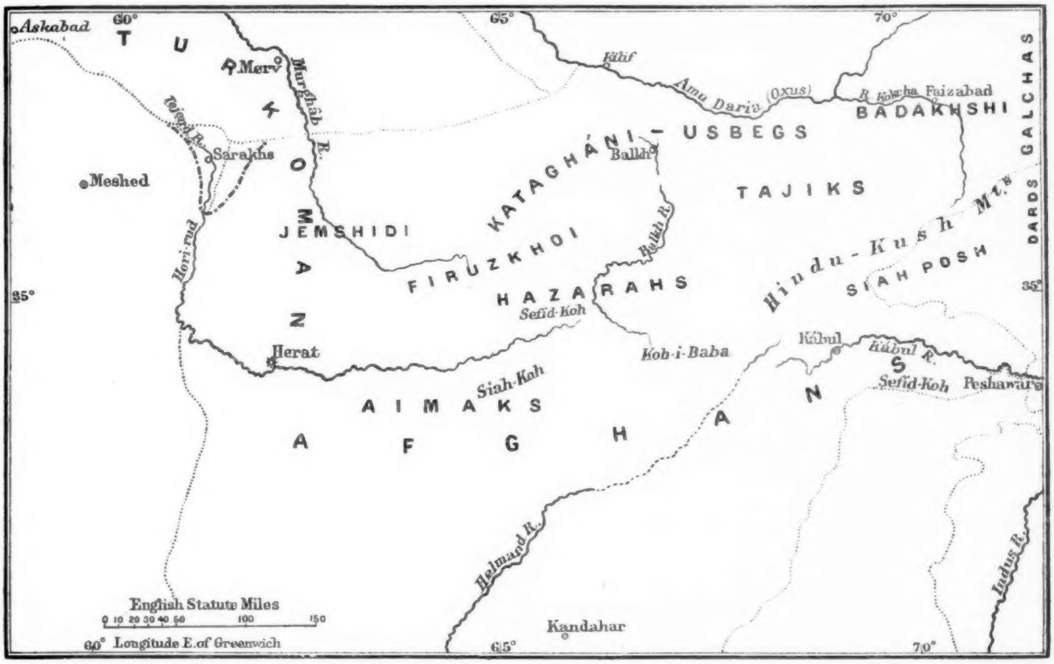
THE NORTH AFGHAN BORDER TRIBES

IN a paper on "Afghan Ethnology," published in NATURE, January 22, 1880, a comprehensive survey was given by this writer of all the varied racial elements in Afghanistan. Here it is proposed to deal exclusively and somewhat more fully with the northern peoples lying along and about the new boundary line proposed to be laid down between the now conterminous Anglo-Indian and Russian empires. Were the importance of ethnological studies understood or recognised by British statesmen, it would be needless to insist upon an accurate knowledge of the tribal relations in this border-land

before determining the future line of demarcation between the two States. As matters stand, nothing can be done beyond supplying a few authentic data, which, if not too late, may possibly help our Boundary Commissioners to appreciate the gravity of the situation.

Politicians of eminence have in recent times spoken flippantly of a great and consolidated Afghan people, one in origin, speech, usages, national aspirations, in friendly alliance with the British *ráj*, destined to constitute a formidable bulwark of the Indian Empire against the further encroachments of the northern Colossus. Those who have conjured up this pleasant vision, and shaped their policy in the belief of its realisation in our days, are doubtless well meaning persons; but they are not practical men of business, dwellers rather in dreamland than sober inhabitants of this planet. Afghanistan is not the home of one, but of many peoples, differing widely in race, language, customs, in some cases even in religion and political institutions; nor are the materials at hand by which these heterogeneous fragments could be welded into a single body politic for many generations to come.

A mere glance at the accompanying sketch map will suffice to show that the Afghan race proper, since the death of Nadir Shah (1747) heir to the former Persian masters of the land, nowhere even approaches the northern frontiers, except in the Herat district towards the north-west. Notwithstanding their great elevation, the mountain ranges stretching from the Hindu-Kush, through the Koh-i-Baba and parallel Safed-Koh and Siah-Koh chains westwards to Khorasán, constitute neither an ethnical, a political, nor even a complete physical parting line between the Afghan plateau and the Turkestan lowlands. The Hindu-Kush itself doubtless forms a distinct "divide" for the waters flowing north to the Oxus, south to the Indus basin. Further west, also, all the head streams of the Murgh-áb, or River of Merv, have their



sources on the northern slope of the Safed-Koh, probably the Paropamisus of the ancients. But here the mountain barrier is completely pierced by the Heri-rud, which takes its rise south of the Koh-i-Baba, and, after flowing a long way west between the Safed-Koh and the Siah-Koh, trends northwards beyond Herat to the Turkestan steppe. Politically, also, the rampart is broken all along the line, both slopes from Kashmir to Persia being claimed and hitherto recognised as integral parts of Afghan territory. Thus the whole of Afghan Turkestán, of Badakhshán, and the more remote north-eastern provinces of Wakhán and Shugnán, are comprised within the Aralo-Caspian hydrographic system.

A clear idea of these geographical features is necessary to a right understanding of the racial conditions in this extremely intricate ethnological region. From before the dawn of history constituting a natural parting line between Irán and Turán, it has, nevertheless, been so repeatedly crossed and re-crossed by the contending floods of migration and conquest, advancing now from the north, now from the south, that throughout the historic period it appears to have always been occupied by peoples both of Mongolic and of Caucasic stock. At present the former are found mainly in the western section, between the meridians of Kábul and Herat, the latter thence eastwards to the Pamir and Indus, each on both slopes of the Iranian escarpment between the 34° and 40° parallels. Of the two the Caucasic appears to be the aboriginal, the Mongolic the intruding, element; and by many ethnologists the upland valleys of the "Indian Caucasus" are regarded, if not as the cradle, at least as the centre of dispersion of the Aryan branch of the Caucasic group. Hence, those members of the Aryan family still occupying both slopes of the Hindu-Kush are supposed to be found, so to say, *in situ*, that is, in undisturbed possession of their primeval homes from the first. Such are, on the south side, the so-called SIAH-POSH, or SIAH-POSH KAFIRS ("Black-clad Infidels"), and further

east the numerous communities often collectively known as DARDS; on the north side the BADAKHSHI, WAKHI, and SHUGNÁNI, to whom, with the other kindred highlanders of Roshán, Darwáz, and Karateghin, beyond the Oxus, Ch. de Ujfalvy has applied the collective term GALCHA. That all are fundamentally of one stock there can be no doubt, although much uncertainty prevails regarding their position in the Aryan family.

The northern group (Badakhshi, Wakhi, Shugnáni) have long been brought within the sphere of Iranian culture. Some are Parsiván, that is, Parsi-zabán, or "Persian-tongued"; others, especially in Wakhan, still retain much of their primitive speech, which appears to be intermediate between the Indic and Iranic members of the Aryan family. But all are at least nominal Mohammedans of the Sunni sect, and recognise the supremacy of the Amir of Kábul. In view of future political intrigue on this extreme north-east frontier, it will be desirable to bear in mind the close affinity and common sympathies of all these communities on both sides of the Upper Oxus.

Even more interesting, and in some respects more important, is the southern group of Siah-Posh Kafirs, who occupy the upland valleys between Kohistán and the Swati district, and even visit the northern pastures west of the Dora Pass, crossing the Hindu-Kush at an altitude of some 16,000 feet. In these mountain fastnesses they have hitherto succeeded in preserving intact not only their primitive speech, usages, and religion, but even their political independence. Although included within the limits of the Amir's possessions, no Afghan ventures to penetrate into their territory, which till quite recently was almost a *terra incognita*. By Major Tanner, and the few other Europeans by whom they have been visited, they are described as of a pure Caucasic type, with regular features, blue and dark eyes, hair varying from brown to black, and altogether the most European in appearance of all Asiatic peoples. With the British rulers of India they claim kindred, trace their descent from Alexander the Great, differ from other Asiatics in the use of chairs and tables, and speak a pure Aryan dialect, showing marked affinities to Sanskrit. Some few in the extreme south and west have become assimilated in speech and religion to their Afghan neighbours, and these Safi and Nemchi, as they are called, serve as the medium of communication between the two races. For obvious reasons the masters of India should cultivate the friendship and alliance of the Siah-Posh highlanders, who, from the name of their most powerful *gali*, or tribe, sometimes take the collective name of Kamoji.

The south-western slopes of the Hindu-Kush north of Kábul are held by several little known tribes vaguely known as KOHISTÁNI, or "Hill men." They occupy the whole district between Kafiristán and the Koh-i-Baba. They are mainly Tajiks, that is, Iranians, probably descended of Persian settlers in pre-Mohammedan times, and still speak a rude Persian dialect. Although now Mohammedans of the Sunni sect, they appear to be an unruly people, owing a reluctant allegiance to the Amir, in this and some other respects differing from the other Tajiks found dispersed in settled communities elsewhere in Afghanistan and throughout the whole of Central Asia. The name, referred to the root *táj* = *crown*, is supposed to mean "crowned," indicating the imperial race that once held sway from the Bosporus to the Indus. But the sceptre has long passed from Irán to Turán even in Persia itself, where the reigning dynasty belongs to the Qajár tribe, of Turkoman stock.

As already stated, both slopes of the North Afghan highlands are in almost exclusive possession of Mongolic peoples from the Koh-i-Baba to Herat, east and west, and from Afghan Turkestan southwards to the Ghor uplands. Here both branches of the Mongolo-Tatar group are represented, the Mongols proper by the HAZARAHS and the AIMAKS, the Tatars by the TURKOMANS and the KATAGHÁNI USBEGS. With the Hazarahs are sometimes grouped the JEMSHÍDIS and FIRUZ-KHOI of the province of Herat. But both of these numerous communities appear to be fundamentally of Iranian stock, although the type has to some extent been modified by contact with the surrounding Mongolo-Tatar tribes.

Thus it appears that, as above remarked, the Afghans proper nowhere occupy any territory along their northern frontier, but, except at Herat, have everywhere been driven into the interior of the plateau by the intruding Central Asiatic races. It is further to be noted that although they hold the Usbegs of the Tirband-i-Turkestán escarpment and of the Turkestán lowlands in military subjection, they have hitherto failed to reduce either the Aimaks of the Ghor district or the Hazarahs of the Koh-i-Baba and Safed-Koh ranges. The direct route from Herat to Kábul through this region has not only never yet been traversed by any European explorer, but is absolutely inaccessible to the Afghans themselves. Hence it is that the military and trade route between these two points is deflected a long way southwards to the Helmand basin and to Kandahar, whence it laboriously creeps up through the Ghazni highlands to the Kábul valley.[1] Hence also the vast strategic importance of such places as Kandahar and Girishk on the Helmand, which depends, not, as is generally supposed, so much on the lie of the land, as on the ethnical conditions of its inhabitants. The future masters of the Aimak and Hazarah tribes will not only secure the rich prize of the Ghor region, with its untouched mines of gold, silver, copper, lead, iron, coal, sulphur, rubies, and emeralds, but will also command the direct and natural route from Herat to the Indus, *viâ* Kábul and Pesháwar.

Meantime, these Aimaks and Hazarahs, neglected by our statesmen, continue to interest our men of science alone. Their flat features, tawny complexion, scant beard, oblique eyes, and prominent zygomatic arches, betray their common Mongolic descent, while the somewhat rude Persian dialect generally spoken by both implies long contact in their new homes with Iranian culture. Both are also Mohammedans; the Aimaks of the Sunni, the Hazarahs of the Shiah sect, in this respect differing from all other Mongolian tribes, who are exclusively Buddhists. Another proof of Persian influence is the settled life of the Hazarahs,[2] who have long ceased to be nomads, and now occupy permanent villages of small thatched houses. Of late years they have begun to migrate towards India, where they find employment on the public works.

The Aimaks, or Char Aimaks, that is "Four Hordes," so named from their four main divisions, occupy, besides the Ghor country, extensive tracts on the northern slope of the border ranges, on the hills encircling Herat, and beyond the frontier in Khorasán. Some communities in the Herat district have preserved their mother-tongue, and their chief tribe even still bears the Mongol name of Kipchak. They also retain the old *urdu*, or tents made of felt or skins, and usually grouped round a central tower or stronghold occupied by the chief. They are described as altogether more savage and ferocious than their Hazarah neighbours, and are even said to drink the blood of the slain in battle (Elphinstone).

With the fall of Merv all the hitherto independent Turkoman tribes passed under the sceptre of the "White Czar," except the SARIKS and the SALORS. Soon after that event the Sariks of the Merv oasis gave in their submission to the number of about 10,000 families. When that district was invaded in 1860 by the Tekkés, the Salors, its original masters, withdrew higher up the Murgháb valley, where they are still found within and about the Afghan frontier, on the route between Merv and

[1] The direct route is little over 360 miles, the detour by Kandahar about 550.

[2] Probably so named from the Persian *hazár* = a thousand, in allusion their numerous tribal subdivisions.

Herat. They do not recognise the authority of the Amir of Kábul, and should the Czar, who is about to assume the title of "Emperor of Central Asia," claim the allegiance of this outlying Central Asiatic tribe, here will be a fruitful source of future complications. Their submission would at once advance the Russian frontier far into Afghan territory and up the Murgháb valley to within easy distance of Herat from the north. The route in this direction is well known, and constantly traversed by traders from Khiva, Bokhara, and Samarkand. It appears to present no greater difficulties than the more westerly route crossing the Barkhut ridge recently surveyed by Lessar.

There remain to be mentioned the KATAGHÁNI USBEGS, who form the bulk of the population in Afghan Turkestán. They belong to the same ethnical group as the Usbegs of the Khanates, and have even some settlements in Bokhara beyond the Oxus. They are mostly agriculturists and traders, Sunnite Mohammedans of pure Turki speech, and bear with reluctance the hard yoke of their Afghan masters. Their sympathies are entirely with their northern kinsmen, and as the country (Kunduz, Balkh, Maimene) belongs geographically to the Aralo-Caspian basin, it is difficult to see how further rectifications of frontier can ultimately be prevented in this direction. Exponents of advanced public opinion in Russia already openly claim the whole of this region to the crest of the Hindu-Kush as properly belonging to the ruler of Central Asia, and their arguments are largely based on ethnological grounds.

Table of the North Afghan Border Tribes

CAUCASIC STOCK

	Tribe	*Locality*	*Population*[1]
Galchas	Siah-Posh	Kafiristán	150,000
	Badakhshi	Badakhshán	160,000
	Wakhi	Wakhán	3,000
	Shugnáni	Shugnán	25,000
Iranians	Kohistáni	Kohistán	?
	Firuz-Khoi	Prov. Herat, Murgháb Valley	30,000 tents
	Jemshidi	Prov. Herat, Khushk Valley	12,000 families
	Tajiks...	Herat, Balkh, &c.	200,000 ?
	Afghans	Herat...	100,000 ?

MONGOLIC STOCK

	Tribe	*Locality*	*Population*
Tatars Mongols	Hazarahs	Hazáraját ... ... Koh-i-Baba, Safed-Koh ...	300,000
	Aimaks	Ghor, Herat, Khorasán ...	350,000
	Salor Turkomans	About-Martshag, Murgháb Valley	30,000
	Kataghání Usbegs	Afghan Turkestán, Bokhara	600,000

A. H. KEANE

[1] Population mostly conjectural.

ANTHROPOMETRIC PER-CENTILES

I SEND the following Table, partly to exemplify what I trust will be found a convenient development of a statistical method that I have long advocated, and partly for its intrinsic value, whatever that may be. It will at all events interest those of the 9337 persons measured in my Anthropometric Laboratory at the late International Health Exhibition, who may wish to discover their rank among the rest.

Its meaning is plain, and will be understood by the help of a single example, for which I will take the line referring to Strength of Squeeze among males. We see that a discussion was made of 519 measurements in that respect, of men whose ages ranged between 23 and 26; that 95 per cent. of them were able to exert a squeeze with their strongest hand (the squeeze was measured by a spring dynamometer) that surpassed 67 lbs. of pressure; that 90 per cent. could exert one that surpassed 71; 80 per cent. one that surpassed 76; and so on. The value which 50 per cent. exceeded, and 50 per cent. fell short of, is the Median Value, or the 50th per-centile, and this is practically the same as the Mean Value; its amount is 85 lbs. This line of the Table consequently presents an exact and very complete account of the distribution of strength in one respect among the middle 90 per cent. of any group of males of the tabular ages similar to those who were measured at the laboratory. The 5 per cent. lowest and the 5 per cent. highest cannot be derived directly from it, but their values may be approximately inferred from the run of the tabular figures, supplemented by such deductions as the Law of Error may encourage us to draw. Those who wish to apply this law will note that the probable error is half the difference between the 25th and the 75th per-centile, which can easily be found by interpolation, and they will draw the per-centiles that correspond respectively to the median value *minus* twice, three times, and three-and-a-half times the probable error, at the graduations 8·7, 2·4, 0·8, and those that correspond to the median value *plus* those amounts, at the graduations 91·3, 97·6, and 99·2. The Table is a mere statement of observed fact; there is no theory whatever involved in its construction, beyond simple interpolations between values that differ little from one another and which have been found to run in very regular series.

It may be used in many ways. Suppose, for example, that a man of the tabular age, viz. above 23 and under 26, and who could exert a squeeze of 80 lbs., desired to know his rank among the rest, the Table tells him at once that his strength in this respect certainly exceeds that of 30 per cent. of those who were measured, because if it had been only 79 lbs. it would have done so. It also tells him that his strength does not exceed that of 40 per cent. of the rest, since it would have required a pressure of 82 lbs. to have done this. He therefore ranks between the 30th and the 40th per-centile, and a very simple mental sum in proportion shows his place to be about the 33rd or 34th in a class of 100.

The Table exhibits in a very striking way the differences between the two sexes. The 5th male per-centile of strength of squeeze is equal to the 90th female per-centile, which is nearly but not quite the same as saying that the man who ranks 5th from the bottom of a class of 100 males would rank 10th from the top in a class of 100 females. The small difference between the two forms of expression will be explained further on. If the male per-centiles of strength of squeeze are plotted on ruled paper, beginning with the lowest, and if the female per-centiles are plotted on the same paper, beginning with the highest, the curves joining their respective tops will be found to intersect at the 7th per-centile, which is the value that 7 of the females and 93 of the males just surpass. Therefore, if we wished to select the 100 strongest individuals out of two groups, one consisting of 100 males chosen at random, and the other of 100 females, we should take the 100 males and draft out the 7 weakest of them, and draft in the 7 strongest females. Very powerful women exist, but happily perhaps for the repose of the other sex, such gifted women are rare. Out of 1657 adult females of various ages measured at the laboratory, the strongest could only exert a squeeze of 86 lbs. or about that of a medium man. The population of England hardly contains enough material to form even a few regiments of efficient Amazons.

The various measurements of males surpass those of females in very different degrees, but in nearly every particular. A convenient way of comparing them in each case is that which I have just adopted, of finding the per-centile which has the same value when reckoned from the lower end of the male series, and from the higher end of the female series. When this has been done, the position of the

ANTHROPOMETRIC PER-CENTILES

Values surpassed, and Values unreached, by various percentages of the persons measured at the Anthropometric Laboratory in the late International Health Exhibition

(*The value that is unreached by n per cent. of any large group of measurements, and surpassed by* 100–*n of them, is called its n*th *per-centile*)

Subject of measurement	Age	Unit of measurement	Sex	No. of persons in the group	Values surpassed by per-cents as below: 95	90	80	70	60	50	40	30	20	10	5
					Values unreached by per-cents. as below: 5	10	20	30	40	50	60	70	80	90	95
Height, standing, without shoes ..	23-51	Inches	M.	811	63·2	64·5	65·8	66·5	67·3	67·9	68·5	69·2	70·0	71·3	72·4
			F.	770	58·8	59·9	61·3	62·1	62·7	63·3	63·9	64·6	65·3	66·4	67·3
Height, sitting, from seat of chair ...	23-51	Inches	M.	1013	33·6	34·2	34·9	35·3	35·4	36·0	36·3	36·7	37·1	37·7	38·2
			F.	775	31·8	32·3	32·9	33·3	33·6	33·9	34·2	34·6	34·9	35·6	36·0
Span of arms ...	23-51	Inches	M.	811	65·0	66·1	67·2	68·2	69·0	69·9	70·6	71·4	72·3	73·6	74·8
			F.	770	58·6	59·5	60·7	61·7	62·4	63·0	63·7	64·5	65·4	66·7	68·0
Weight in ordinary indoor clothes...	23-26	Pounds	M.	520	121	125	131	135	139	143	147	150	156	165	172
			F.	276	102	105	110	114	118	122	129	132	136	142	149
Breathing capacity	23-26	Cubic inches	M.	212	161	177	187	199	211	219	226	236	248	277	290
			F.	277	92	102	115	124	131	138	144	151	164	177	186
Strength of pull as archer with bow	23 26	Pounds	M.	519	56	60	64	68	71	74	77	88	82	89	96
			F.	276	30	32	34	36	38	40	42	44	47	51	54
Strength of squeeze with strongest hand	23-26	Pounds	M.	519	67	71	76	79	82	85	88	91	95	100	104
			F.	276	36	39	43	47	49	52	55	58	62	67	72
Swiftness of blow.	23-26	Feet per second	M.	516	13·2	14·1	15·2	16·2	17·3	18·1	19·1	20·0	20·9	22·3	23·6
			F.	271	9·2	10·1	11·3	12·1	12·8	13·4	14·0	14·5	15·1	16·3	16·9
Sight, keenness of—by distance of reading diamond test-type	23-26	Inches	M.	398	13	17	20	22	23	25	26	28	30	32	34
			F.	433	10	12	16	19	22	24	26	27	29	31	32

per-centiles arranged in order of their magnitude are as follows:—Pull, 4; Squeeze, 7; Breathing capacity, 10; Height, 14; Weight, 26; Swiftness of blow, 26; Keenness of sight, 37. We conclude from them that the female differs from the male more conspicuously in strength than in any other particular, and therefore that the commonly used epithet of "the weaker sex," is peculiarly appropriate.

The Table was constructed as follows:—I had groups of appropriate cases extracted for me from the duplicate records by Mr. J. Henry Young, of the General Register Office. I did not care to exhaust the records, but requested him to take as many as seemed in each case to be sufficient to give a trustworthy result for these and other purposes to which I desired to apply them. The precise number was determined by accidental matters of detail that in no way implied a selection of the measurements. The summarised form in which I finally took them in hand, is shown in the two upper lines of the following specimen:—

Height, Sitting, of Female Adults, Aged 23-50, *in inches*

29-	30-	31-	32-	33-	34-	35-	36-	37-	
2	8	52	116	226	227	108	31	5	Total 775
2	10	62	178	404	631	739	770	775	Abscissæ 0 to 775
30	31	32	33	34	35	36	37	38	Corresponding Ordinates

The meaning of the two upper lines is that in a total of 775 observations there were 2 cases measuring 29 and under 30 inches, 8 cases measuring 30 and under 31 inches, and so on. The third line contains the sums of the entries in the second line reckoned from the beginning, and is to be read as follows:—2 cases under 30 inches, 10 cases (= 2 + 8) under 31 inches, 62 cases (= 2 + 8 + 52) under 32 inches, and so on.

I plotted these 775 cases on French "sectional" paper, which is procurable in long and inexpensive rolls, ruled crossways by lines 1 millimetre apart. I counted the first line as 0° and the 776th as 775°. Supposing the measurements to have been plotted in the order of their magnitude, in succession between these lines, the first would stand between 0° and 1°, the second between 1° and 2°, and so on. Now we see from the Table that the second measurement was just short of 30 inches, consequently the third measurement was presumably just beyond it, therefore the abscissa whose value is 2°, and which separates the second from the third measurement, may fairly be taken to represent the abscissa of the ordinate that is equal to 30 inches exactly. Similarly, the abscissa whose value is 10° divides the measurement that is just under 31 inches from that which is presumably just above it, and may be taken as the abscissa to that ordinate whose precise value is 31°, and so on for the rest. The fourth line of the Table gives the ordinates thus determined for the abscissæ whose values are entered above them in the third line. I dotted the values of these ordinates in their right places on the sectional paper, and joined the dots with a line, which in every case, except the breathing capacity, fell into a strikingly regular curve. (I cannot account for this one partial exception, save on the supposition of the somewhat irre-

gular mixture of town and country folk, and of sedentary and active professions among the persons measured, but I have not yet verified this surmise.) Per-centiles were then drawn to the curve corresponding to abscissæ that were respectively 5 per cent., 10 per cent., 20 per cent., &c., of the length of the base line. As the length of the base-line was 275, these per-centiles stood at the graduations $13^{\circ}\cdot8$, $27^{\circ}\cdot5$, $55^{\circ}\cdot0$, &c. Their values, as read off on the sectional paper, are those which I have given in the Table.

It will be understood after a little reflection that the 9th rank in a row of 10, the 90th rank in a row of 100, and the 900th rank in a row of 1000, are not identical, and that none of them are identical with the 90th per-centile. There must always be the difference of one half-place between the post which each person occupies in a row of n individuals, numbered from 1 to n, and that of the corresponding graduations of the base on which they stand, and which bear the same nominal value, because the graduations are numbered from 0 to n and begin at a point one half-place short of the first man, and end at one half-place beyond the last man. Consequently the graduations corresponding to the posts of the 9th, 90th, and 900th man in the above example, refer to the distance of those posts from the beginning at 0 of their several base lines, and those distances are related to the lengths of the base lines in the proportions of 8·5 : 10, 89·5 : 100, and 899·5 : 1000, which when reckoned in per-cents of the several base lines are 85, 89·5, and 89·95 respectively. The larger the number of places in the series, the more insignificant does this half-place become. Moreover, the intrusion of each fresh observation into the series separates its neighbours by almost double that amount, and propagates a disturbance that reaches to either end, though it is diminished to almost nothing by the time it has arrived there. We may therefore ignore the existence of this theoretically troublesome half-place in our ordinary statistical work.

There is a latent source of error that might affect such statistics as these, as well as many others that are drawn up in the usual way, which has not, so far as I know, been recognised, and deserves attention. It is due to uncertainty as to the precise meaning of such headings as 30-, 31-, &c. If the measurements, no matter whether they were made carefully or carelessly, are read off from the instruments with great nicety, then a reading such as 30·99 would fall in the column 30-, and the mean of all the entries in such a column might fairly be referred to a mean value of 30·5.

But if the instruments are roughly read, say, to the nearest half inch, the reading of a real instrumental value of 30·99, and even that of a real value of 30·76, would both be entered in the column 31-. The column 30- would then contain measurements whose real instrumental values ranged between 29·75 and 30·75, and the column 31- would contain those that ranged between 30·75 and 31·75; consequently, the means of all the entries in those columns respectively should be referred, not to 30·5 and 31·5, but to 30·25 and to 31·25. An error of a quarter of an inch in the final results might easily be occasioned by the neglect to note the degree of minuteness with which the instruments were read, and I strongly suspect that many statistical tables are affected by this generally unrecognised cause of error. The measurements at my laboratory were read to the nearest tenth of an inch and to a fraction of a pound, so I can afford to disregard this consideration. There was, however, a slight bias in favour of entering round numbers, which should have been, but were not (because I neglected to give the necessary instructions), rateably divided between the columns on either side.

A fuller description of the results of the measurements at the laboratory will appear next February or March in the forthcoming number of the *Journal* of the Anthropological Institute, at which place the original data will ultimately be deposited.

FRANCIS GALTON

NOTES

It having become known to some of the friends of the late Mr. Henry Watts, the well-known chemist, whose death occurred very suddenly on the 30th of last June, that his widow and family are in very straitened circumstances, an informal meeting was recently held at the Royal Institution. Those present resolved to form themselves into a committee, with power to add to their number, in order to collect a fund for the benefit of Mrs. Watts and those of her children who are not of an age to provide for their own support. Dr. Atkinson consented to act as secretary, and Dr. Perkin, President of the Chemical Society, as treasurer. Among the names on the committee are those of Sir F. A. Abel, Prof. H. E. Armstrong, Mr. William Crookes, Dr. Warren De La Rue, Prof. James Dewar, Prof. G. C. Foster, Dr. J. H. Gladstone, Prof. A. G. V. Harcourt, Dr. Hugo Müller, Dr. William Odling, Dr. W. H. Perkin, Dr. B. W Richardson, Prof. W. Chandler Roberts, Sir H. E. Roscoe, Dr. W. J. Russell and Prof. A. W. Williamson. Mr. Watts's public labours for the advancement of chemical science may be said to have begun with the translation of Gmelin's "Handbook of Chemistry," the admirable English edition of which was prepared and edited for the Cavendish Society by him. This work occupies eighteen large octavo volumes, of which the first appeared in 1849, and the last in 1871. A work scarcely, if at all, inferior to this in magnitude, and one which has perhaps been of even greater service to English chemists, both scientific and industrial, is Watts's great "Dictionary of Chemistry," which appeared from 1863 to 1881, in eight volumes, containing altogether nearly 9700 pages. Mr. Watts also edited and largely added to the second volume of the late Prof. Graham's "Elements of Chemistry," published in 1858; he prepared several editions of Fownes's well-known "Manual of Chemistry," which he almost entirely re-wrote and made into virtually a new work; and in conjunction with Mr. Ronalds and Dr. Richardson, he prepared for Messrs. Baillière an elaborate treatise on chemical technology. Up to the time of his death, and for about thirty years previously, Mr. Watts was editor of the *Journal* of the Chemical Society, and in this capacity, as well as in that of librarian to the Chemical Society, he became personally known to and gained the friendship of very many among the Fellows of the Society. But although Mr. Watts's life was one of unremitting labour, the money return for his work was barely sufficient to enable him to provide for the daily wants of a delicate wife and a numerous family. It was not possible for him to provide for their future needs. But if he could not leave behind him pecuniary resources, he accumulated esteem and affection among all who knew him, which, it is confidently hoped, will prove a valuable legacy for those who were dependent on him. The facts of the case show that there is great need of whatever practical proof of their regard for him and appreciation of his labours Mr. Watts's friends, and English chemists generally, may be willing to make. For many years Mrs. Watts has been in ill-health, so that she cannot do anything for her own support and that of her family. One son is a permanent invalid, and the four youngest children have still to be educated. A considerable expenditure is therefore unavoidable for a good many years to come, if the children are to have a fair chance of a start in life. A considerable sum has already been promised in the way of subscriptions, but much more will have to be done in order that any substantial benefit may accrue to Mrs. Watts and her young family. Subscriptions will be received and acknowledged

by the Secretary, Dr. Edmund Atkinson, Portesbery Hill, Camberley, Surrey, or by the Treasurer, Dr. W. H. Perkin, the Chestnuts, Sudbury, Harrow.

M. MILNE EDWARDS has been nominated by the French Government Grand Officer of the Legion d'Honneur.

LECTURES in connection with the London Society for the Extension of University Teaching have been going on in Whitechapel now for more than six years. The number of tickets sold for the lectures during this period has been close upon 2000, and the ticket-holders have been nearly all artisans. The reports of the examiners, appointed by the Universities' Board, have shown that many of those attending the lectures are real students—a conclusion which is also borne out by the fact that the same subjects have been studied for several years in succession. It has been felt that a good reference library and reading room would be a great help to the existing students, as well as a means of attracting others. An opportunity for providing these advantages is now afforded in the "Universities' Settlement" in Toynbee Hall, where the lectures will in future be given, and a reading room be opened to the students. The Committee desire to stock this room with a good reference library—especially in the subjects of history, political economy, physics, and physiology—and will be very grateful for any assistance in this attempt to further higher education among working men and women in East London. Any one willing to help, either with books or with money, is requested to communicate either with E. T. Cook, 22, Albemarle Street, W. (Sec. London Society for the Extension of University Teaching), or Bolton King, 28, Commercial Street, E. (Hon. Sec. Whitechapel Local Committee).

THE mean-time clocks at the Royal Observatory, Greenwich, were put forward twelve hours a little before midnight of December 31, in order that the commencement of the civil day and the astronomical day might be identical from January 1, 1885. The public clock near the entrance to the Observatory will thus indicate the hours as recommended by the Washington Conference—*i.e.* reckoning from 0h. to 24h., starting from midnight. As the Greenwich observations for 1885 will not be printed until 1886, the proposed method can be tried for a year before the necessity of deciding on its adoption will arise. In writing to the Rev. T. E. Espin, President of the Liverpool Astronomical Society, the Astronomer-Royal says:—"The change that we propose to make at Greenwich is for the present provisional only, as it appears essential that it should be generally accepted by astronomers before it is introduced into any published observations. I am very anxious to avoid the confusion which would result from two systems of reckoning time being in use among astronomers. But as regards the ordinary public, it seems to me clear that for civil reckoning the day must commence at midnight, and in order to assist in familiarising the public with the reckoning from 0h. to 24h., I propose on January 1 to alter our public clock (which is numbered from 0h. to 24h.) by 12h., so that it will show civil reckoning instead of the old astronomical reckoning."

CHEMISTS will regret to learn that Dr. Edward Divers, Principal of the Imperial College of Engineering, Tokio, Japan, has met with a very serious accident, which it is feared will result in the loss of one of his eyes. He is understood to have been engaged in work in connection with the theory of acids, when a bottle, supposed to contain terchloride of phosphorus, exploded, causing him very severe injuries. Dr. Divers is well known as the author of many valuable chemical papers read before the Royal and other scientific societies.

MR. ALFRED TYLOR, F.G.S., who died on December 31 last, will be remembered as a promoter of technical education at a time when its vital importance was little recognised, and the English manufacturing mind was generally set against it. He was intimately associated with Dr. von Steinbeis, whose energy in this direction did so much to give the little kingdom of Wurtemburg its industrial prominence in Germany. Mr. Tylor's work, "Education and Manufactures," arising out of his Jury Report on Metal Work at the Exhibition of 1862, was translated into German under the title "Industrie und Schule" (Stuttgart, 1865), and also appeared in Swedish. Mr. Tylor sat for some years on the Council of the Geological Society. His geological papers relate principally to the flow of rivers as connected with the erosion of valleys and the deposit of gravel-beds; they contain much systematised information, for instance, as to the mechanical action of the Mississippi and the Ganges. It is well known that his study of river-valleys and drift-gravels led him to the hypothesis of a post-glacial time of enormous rainfall, which he called the "pluvial period." The term, though not generally accepted, is found of use, to judge from its not unfrequent appearance in geological works.

THE death is announced, at the age of seventy-four years, of Dr. Andrew Findlater, for so many years connected with the editorial department of Messrs. W. and R. Chambers. Dr. Findlater wrote several of the scientific volumes in Chambers's well-known "Educational Course," and edited a revised edition of the "Information for the People." But his most important undertaking was the editing of "Chambers's Encyclopædia," the scientific articles in which hold so high a place, mainly through Dr. Findlater's knowledge, discernment, and tact in obtaining the right men to act as contributors. Dr. Findlater was offered the editorship of the new edition of the "Encyclopædia Britannica," but was induced to decline it.

WE read in the German papers that the Greek Government has offered to supply the marble, as it did in the case of Lord Byron's monument in England, for a national monument to be erected to Wilhelm Müller, the father of Prof. Max Müller, in his native town of Dessau. Wilhelm Müller is best known as the poet of the "Müller-lieder," beautifully set to music by Schubert. But the Greek Government, in the name of the Greek nation, wished to express its recognition of the great services rendered to the cause of Greek independence by Wilhelm Müller, "the Philhellenic Tyrtæus," whose "Griechenlieder" belong to the classical literature of Germany. Committees have been formed in Germany, Italy, Greece, and America. The English committee consists of Mrs. Jenny Lind-Goldschmidt, Sir Theodore Martin, Sir Robert Morier, Sir George Grove, J. A. Froude, and Prof. Buchheim. Subscriptions are received by Messrs. Williams and Norgate, 14, Henrietta Street, W.C.

BAVARIAN papers report the death, after a short illness, of Dr. Philip von Jolly, Professor of Mathematical and Experimental Physics in the University of Munich, in the seventy-fifth year of his age.

A NEW association has been established among the students of the University of Paris. The first step of this institution has been the organisation of a public manifestation in honour of M. Chevreul, the director of the Museum, who is just completing his 100th year. He is the first French academician who has reached this advanced age since the death of Fontenelle, who died about 1750, a few days before completing his century. A little before his death Fontenelle was heard to say to one of his friends asking if he complained of some illness, "I have no suffering, but I am feeling merely an increased difficulty of living."

WE learn from *Science* that the "cold-wave flag," whose use has been inaugurated by the U.S. Signal Service during the past autumn, is intended to be displayed not only at the regular

stations of the Signal Service, but also at as many railway-stations and post-offices as possible, in order to spread the widest notice of the coming change of weather. The service cannot at present undertake to provide the flags or to pay for special telegrams to numerous local display-stations; but the cost of the flags (white, six feet square, with a two-foot black square in centre) is moderate, and can easily be borne by those interested in securing early indications of falling temperature; and in several parts of the country the telegrams are sent to all the stations on certain railroads that co-operate with the Signal Service, and thus promptly distribute weather forecasts to the towns along their routes. It is probable that the coming year will see a considerable extension of this kind of weather service.

M. JAMIN, the Perpetual Secretary of the Paris Academy of Sciences, has published, in the January issue of *Revue des Deux Mondes*, the essay on balloons, which we announced a few weeks ago. The academician takes a very moderate view of the success of the Meudon and Point du Jour experiments.

THE terrestrial disturbance in Southern Spain, which began with violent earthquake shocks on Christmas night, still continues, and other earthquakes are reported from Austria and Italy. From Vienna information comes of repeated shocks on the 4th inst. in the hot-spring district of Southern Styria, during which some slight damage was done, while on the afternoon of the same day a shock, perhaps of the same earthquake, was felt at Susa, near Mont Cenis, and one of greater force on the morning of the following day (January 5) at Velletri, near Rome. The seismic instruments at the observatory in Rome and at Rocca di Papa showed unusual activity on the 5th and previous days, especially at midday, and at night the mineral springs in the Island of Ischia have risen in temperature. It would thus appear that the present is a period of unusual seismic disturbance throughout Southern Europe. In Spain no day has passed since the 25th ult. without one or more severe shocks in the disturbed area. On the 31st ult. the tenth violent shock in a week occurred in Granada—the people left their houses for the night—and up to that date 10,000 people had left the town altogether. On the same day and on the 1st inst. shocks continued at Jaen, Torrox, Malaga, Benamargoza, and Velez Malaga. At Torrox buildings were thrown down, and the town has been wholly abandoned. At Nerja the church was damaged, and at Arenas del Rey 500 persons were either killed or injured. On the 1st inst. and the morning of the 2nd fresh shocks were felt at Nerja, Algarrobo, Granada, and Malaga. A number of towns and villages are reported completely destroyed and deserted. On the 2nd shocks were felt along the Mediterranean coast of Granada and Malaga. Up to noon on the 3rd inst., according to official statistics, 673 bodies were recovered from the ruins of towns in the province of Granada alone. On that day the shocks were renewed in Loja, Alhama, Jaen, and Velez Malaga, fissures being made in the ground. The town of Alhama, which has suffered most severely of all, is composed of two parts, the upper and lower. During the earthquake on Christmas night the upper town, situated on the side of a valley, fell into the lower portion. Over 1500 houses were destroyed, and more than 300 dead were recovered up to the 4th inst. It is calculated that 10,000 head of cattle were killed. Besides this, five churches, five convents and hospitals, the town-hall, the prisons, clubs, and theatre were destroyed, and 7000 people rendered homeless. On the 5th a sharp shock occurred at Granada a few minutes after 6 in the evening, and some slight shocks were felt at Malaga.

AT the Royal Institution, Prof. H. N. Moseley will, on Tuesday next (January 13), begin a course of five lectures on "Colonial Animals, their Structure and Life Histories"; Prof. Dewar will, on Thursday (January 15), begin a course of eleven lectures on "The New Chemistry"; and Dr. Waldstein will, on Saturday (January 17), begin a course of three lectures on "Greek Sculpture from Pheidias to the Roman Era." The Friday evening meetings will begin on January 16, when Prof. Tyndall will give a discourse on "Living Contagia."

ACCORDING to the *North China Herald* there died a few months ago at Pekin, the greatest Chinese mathematician of the present century. His name was Li Shan-lan, and he was Professor of Mathematics at the Foreign College in the Chinese Capital. He differed from the mathematicians of Europe in this respect, that he denied the non-existence of a point. "A point," said Prof. Li, "is an infinitesimally small cube," and in saying this he only reproduced the theories of Chinese sophists 2000 years ago. A great writer of that age put into the mouth of a sophistical being, whom he called the god of the northern sea, the following theory, which has its bearing on Prof. Li's heterodox views about a mathematical point: Subtlety is the occult part of the minute. Be a thing subtle or gross, it seems to me that it must have a form. A formless or unsubstantial thing cannot be distinguished as gross or subtle, discriminate as minutely as you will. What can be spoken of is the gross or palpable part of an entity; what can be imagined only is its subtle part or essence; but I take it that what is neither gross nor subtle can neither be talked of nor imagined.

M. LAUTH, the superintendent of the porcelain factory at Sèvres, is said to have discovered a new porcelain, which is far superior to the famous old Sèvres. After ten years' experiment and investigation he thinks he has produced a porcelain identical with that of China. Not only does it lend itself to artistic decoration, but it takes all kinds of glazes, and surpasses in beauty the colours obtained in China.

A PROPOSITION to connect Sicily with the mainland, by a submarine railway from Messina to Reggio, has been made by the Society of Engineering of Venice. It has been laid before the Minister of Public Works, who has referred it to a technical commission. A project by the French engineer who constructed the first railways in Rome to build a suspension bridge across the Straits of Messina, was laid at the time before Francis II.; but Garibaldi's campaign in Sicily, and the subsequent political events, caused it to be put aside.

WE learn from an Adelaide paper of November 3, 1884, that Mr. Clement L. Wragge has now extended his plan of operations on Mount Lofty, and has established, as a further experiment, a substantially equipped meteorological observatory there. At the Torrens Observatory readings are taken in direct connection with the observations on the Mount, 2350 feet.

PROF. SYLVESTER asks us to state that in his article "On the Genesis of an Idea," the footnote on p. 36, left-hand column, should read:—"It is one of Descartes' 'self-evident primary truths' that nothing which has happened could not have happened or have happened otherwise." The words "have happened" unfortunately dropped out.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii* ♂) from South Africa, presented by Mr. J. W. Moon; a Bonnet Monkey (*Macacus sinicus* ♀) from India, presented by Mrs. M. E. Mackern; a Brown Hyæna (*Hyæna brunnea*) from South Africa, presented by Mr. R. W. Murray; a Nubian Ibex (*Capra nubiana* ♂), a —— Ibex (*Capra* —— ♂), a Domestic Goat (*Capra hircus* ♀) from the Soudan, presented by Mrs. Laing; seven Angulated Tortoises (*Chersina angulata*), two Hoary Snakes (*Coronella cana*), a Many-spotted Snake (*Coronella multimaculata*), a Robben Island Snake (*Coronella phocarum*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; a Golden Eagle (*Aquila chrysaetos*), European, deposited; a —— Gibbon (*Hylobates* ——) from Siam, purchased.

OUR ASTRONOMICAL COLUMN

THE TOTAL SOLAR ECLIPSE OF 1914, AUGUST 20-21.—There have been given in this column, at various times, particulars of the track of the central line in a number of the total eclipses of the sun that will occur during the next thirty years. To these may be added similar notes on the eclipse of August 20-21, 1914, which is a return of that of July 29, 1878, so extensively observed in the United States. The elements of this eclipse are very approximately as follow:—

G.M.T. of Conjunction in R.A. 1914, August 20, 23h. 55m. 3s.

	°	′	″	
R.A.	149	45	36·1	
Moon's hourly motion in R.A. ...		33	7·5	
Sun's ,, ,, ...		2	18·9	
Moon's declination	13	9	42·2	N.
Sun's ,, ...	12	19	29·1	N.
Moon's hourly motion in declination		15	16·0	S.
Sun's ,, ,, ,, ...			49·7	S.
Moon's horizontal parallax		59	17·6	
Sun's ,, ,, ...			8·7	
Moon's geocentric semi-diameter ...		16	11·0	
Sun's ,, ,, ,, ...		15	51·1	

Hence it will be found that the

	°	′		°	′	
Total eclipse begins in long.	120	42	W., lat.	71	21	N.
,, ,, at 0h. ,,	2	0	E. ,,	70	42	N.
,, ,, ends ,,	70	26	E. ,,	23	52	N.

In traversing the European continent, the central line runs through the points

Long.		Lat.	Long.		Lat.
12° 33′ E.	...	65° 48′ N.	30° 33′ E.	...	50° 35′ N.
14 39 ,,	...	64 32 ,,	32 53 ,,	...	48 2 ,,
22 44 ,,	...	58 23 ,,	39 12 ,,	...	41 23 ,,
27 30 ,,	...	53 48 ,,	46 28 ,,	...	34 52 ,,

The first of these points is close upon the coast of Norway, at the Island of Alstahoug, and on making a direct calculation for it, the totality is found to commence at 0h. 54m. 19s. local mean time, continuing 1m. 59s., with the sun at an altitude of 37°, and this will be about the most favourable position for observation.

THE MINOR PLANETS.—That part of the *Berliner Astronomisches Jahrbuch* for 1887, containing its speciality, the ephemerides of the small planets for 1885, has been issued in advance of the publication of the volume. There are approximate places for every twentieth day of 237 out of the 244 now known, with accurately calculated opposition-ephemerides of 19. The most reliable elements of the orbits of these bodies to No. 237 inclusive are appended. *Æthra* continues at a distance of less than 1·0 from the earth until February 11, and if the orbit had been more closely determined, would have afforded a favourable opportunity of applying the method of finding the solar parallax suggested by Prof. Galle, as the planet has been a ninth magnitude at this opposition. *Eva*, *Stephania*, and *Agathe*, also approach the earth during the present year, within her mean distance from the sun; on August 10 *Stephania* will be at a distance of only 0·76, magnitude 11½.

Æthra has the least perihelion distance of the group, 1·604, while *Andromache*, with a considerable excentricity, has the greatest aphelion distance, 4·726, so that the orbits of the 244 planets extend over a space of 3·122, the earth's mean distance from the sun being taken as unity. The longest period of revolution occurs in the case of *Hilda*; it is yet doubtful which has the shortest period; No. 149 *Medusa* is credited with it at present, but until this member of the group has been re-observed, the point is perhaps doubtful. The most recently detected planet appears to have the shortest revolution next to *Medusa*, judging from the elements in the last circular of the *Berliner Jahrbuch*.

THE BRIGHTNESS OF SATURN.—Dr. G. Müller, of the Observatory at Potsdam, notifies in a recent number of the *Astronomische Nachrichten*, that since the year 1878 he has made regular photometric observations on Saturn, the main result of which he states to be, that when the earth is at an elevation of 26° above the plane of the ring, the planet's light is 2·4 times greater than when the earth is in that plane, or, in other words, that the brightness of Saturn's rings, when the earth is 26° from their plane, amounts to 58·3 per cent. of the brightness of the whole Saturnian system.

ENCKE'S COMET.—This comet appears to have been re-observed both in Europe and the United States; a somewhat doubtful observation by Dr. Tempel at Florence shows that the predicted elements will require probably but small correction. Taking aberration into account, the calculated position on December 13 differed from that observed, + 1′·1 in right ascension, and + 1′·2 in declination; the theoretical intensity of light on this date was 0·193. In 1852, when the perihelion passage occurred a week only later than in the present year, the comet was first observed on January 9, the intensity of light being 0·228.

GEOGRAPHICAL NOTES

THE lectures given under the auspices of the Paris Geographical Society last spring were so successful, that they are to be resumed this year. The first will be given by M. Janssen, on January 13, on the universal meridian. The others will be, by Prof. de Lapparent, on January 27, on the formation and development of the earth's crust; February 3, M. Bouquet de la Grye, the oceans; February 10, Dr. Hamy, man; March 3, M. Himly, the conquest of the globe; March 10, M. Levasseur, the riches of the globe; March 24, M. Louis Simonin, the great lines of navigation; March 31, M. Michel, railways and their relation to geography. These lectures are not free even to members, the charge for the course to such being fifteen francs, and twenty francs to outsiders. Some of the lectures will be illustrated with projections on the screen, and the success of the enterprise is so assured that a third series has already been arranged for in 1886.

MR. H. H. JOHNSTON writes as follows to the *Times*:—"The Kilimanjaro Expedition which I have just undertaken has resulted in a pleasant and healthy sojourn in one of the most beautiful and interesting regions in the world. I arrived at the mountain in the beginning of June, and settled first in Mandara's territory, on the southern slopes. Here I built a small town of about twenty houses and passed four months in collecting and making numberless excursions right and left. The climate was that of a Devonshire summer, provisions were abundant, cheap, and of great variety, and I was only fearful lest this delightful region might become to me a Capua, and deter me from the more important work that awaited me at a higher level than could be attained within the limits of Mandara's kingdom. Accordingly, when I had received from the coast a reinforcement of hardier men, I established myself at a height of 11,000 feet, and here built an even larger village than my settlement at Moshi. This was on a splendid site. A mountain torrent dashed past our circle of pretty thatched cottages, which surmounted a grassy knoll above the stream; to the south of us spread a wondrous prospect of sun-lit plains and distant rivers—a veritable map of Eastern Africa—and to the north rose the unspeakably grand summits of the mountain mass—Kibö, a dazzling dome of virgin white, and Kimawenzi, a piebald peak of black, jagged rocks, seamed and flecked with snow. From this settlement I constantly ascended as far as I was able in one day's journey, but the difficulties which lay in the way of a complete ascent of either peak arose from the impossibility of inducing any of my followers to accompany me beyond 14,000 feet, for above this altitude they suffered so keenly from cold and mountain sickness that no persuasion or bribes would induce them to ascend any higher, far less to carry any of my *impedimenta*. Consequently, I could never get beyond a certain distance from the settlement, the cold not permitting me to risk the chance of being benighted in the snow. I reached, however, an altitude of 16,200 feet, a little more than 2000 feet from the summit of Kibö, (18,800 feet high). I found warm springs at 14,400 feet, detected no signs of glacial action, and was somewhat disappointed with the paucity of plants growing at the snow line. Birds were very rare above 10,000 feet, and very abundant below. Lizards and chameleons existed (and frogs also) up to the very snow. Hyraxes (the hyrax is the coney of Scripture) were common between 8000 and 13,000 feet, and I fancy are represented by a new species. Buffaloes and elephants ascended to 14,000 feet. The thunderstorms that frequently rage round the upper slopes of the mountain are terrific, and the wind at times is so violent that no one can keep their feet. The natives who

inhabit Kilimanjaro up to 6000 feet, are fairly tractable, and have a passionate love of trade, which with them is the great pacifier. They go absolutely naked, or if any clothing is worn in the way of ornament it rarely goes beyond leather capes for the shoulders. They all speak dialects belonging to the great Bantu group of languages. I have studied carefully several of them, and have, I believe, discovered some most interesting points in their construction likely to throw considerable light on the archaic forms of Bantu prefixes. I may add that, after a very happy sojourn in the lovely forest region of Taveita at the foot of the mountain, I was compelled to return most reluctantly to the coast at the end of November owing to the exhaustion of my funds. I left Kilimanjaro with great regret, and on my homeward journey my thoughts were persistently directed to my whilom African home, rather than to an unwilling and too early return to civilisation. My collections have safely reached this country, and will, I hope, be sufficient to indicate the true character and relationships of the fauna and flora of Kilimanjaro."

THE death is announced at Lübeck of Dr. Robert Avé-Lallemant, at one time a well-known traveller in South America. He became surgeon to the Novara expedition, which, however, he left at Rio, in order to devote himself to exploration in Brazil. In 1858 he went to Rio Grande do Sul, where he commenced his journey into Southern Brazil, during which he visited Bonpland, a few months before his death, in his lonely ranche in Paraguay. He crossed the Uruguay Allegrette, San Gabriel, and Cacapava to the Jacuy. From San José he went along the coast to Laguna, visited the sources of the Uruguay, and returned to San José through forests still unknown to travellers. This journey lasted about a year, and soon after his return he again set out to travel through the northern provinces. Landing at Bahia, he followed the coast to the Mucury river. Here he discovered the shocking condition of some of the German colonies. Thence he went to Pernambuco, and ascended the Amazon to Tabatinga, on the Peruvian frontier. On these journeys he published two large works ("Reise durch Süd Brasilien, 1859," and a similar work on North Brazil), and numerous smaller ones. They give no new geographical discoveries or exact measurements, or the results of scientific investigation, but they contain valuable information respecting the country, the fauna and flora, and condition of the people. The later years of his life were spent in medical practice in his native city.

ACCORDING to *L'Exploration*, the Argentine authorities are sending an expedition to the Chaco. It consists of 200 men, divided into three columns, operating from different points, but meeting at Cangayé, a centre almost equally distant from Salta and Paraguay. The object is both military and scientific. It is desired to secure the possession of this vast territory to the Argentine Republic against the Indians, who are again masters there. Six topographical commissions are attached to the expedition in order to study the country, prepare maps, and also, it is said, to investigate the possibility of a railway as far as Oran, in the province of Salta. The investigation of the rivers, for which the gunboat *Pilcomayo* is sent, has been delayed by the low state of the water, but recent rains will now enable that work to be proceeded with. If the result should be the demonstration of the suitability of the *Pilcomayo* to navigation, not only will a great service be rendered to topographical science, but by assuring communications between Bolivia and the Rio Paraguay, a great economical revolution will, it is expected, be produced in these regions.

EXPERIMENTS SUITABLE FOR ILLUSTRATING ELEMENTARY INSTRUCTION IN CHEMISTRY

PROFESSORS SIR H. E. ROSCOE and W. J. Russell, by direction of the Lords of the Committee of Council on Education, have recently prepared, for the assistance of teachers of science schools and classes, an outline of experiments in chemistry. As this subject is now under discussion, we are glad to be able to give the outline *in extenso* in NATURE.

The notes have been prepared as some guide to the teachers as to the general character of the course of instruction expected in the elementary stage; they include instruction that should on no account be omitted, but must be considered rather as suggestive than exhaustive.

I.—*Combustion and Chemical Combination*

1. Burn a taper in a clean glass bottle. Show the presence of a colourless gas, differing in properties from common air by yielding a turbidity with lime-water.

2. Hold a bright glass over a burning candle and show the formation of water.

Explain what is meant by chemical change, and state that chemistry is an experimental science.

3. Make similar experiments with a petroleum or paraffin lamp.

4. Show that coal-gas also yields the same products by passing the products of combustion through lime-water and by collecting the water.

5. Explain the difference between mechanical mixture and chemical combination; and illustrate by a mixture of finely-divided copper and flour of sulphur, and the effect of heat upon the same.

6. Experiment to show that chemical change consists of a change in the properties of matter and that no loss of matter takes place. Suspend lamp chimney, partly filled with lumps of caustic soda, from the arm of a balance. Place short piece of candle in the lower part of the glass and counterbalance. Light the candle. Explain the increase in weight.

7. Heat is evolved when chemical combination takes place. Pour water on to quicklime. Refer also to experiments 1 and 3.

8. Combustibles and supporters of combustion. The purely relative character of these terms. Ordinary combustion the union of atmospheric oxygen with a body termed the combustible, or with one or more of its constituents, heat being developed, as in all cases where two or more bodies combine. Illustrate by showing that air will burn in coal-gas just as well as coal-gas will burn in air.

II.—*Air*

1. Existence of atmosphere, felt in winds.

2. Weight of air shown by means of a flask exhausted by the air-pump.

3. Burn phosphorus in air.

4. Burn phosphorus in confined volume of air and show diminution in bulk.

5. Show that some diminution takes place slowly when a stick of phosphorus is exposed to air at ordinary temperatures.

6. Test residual gas (N) with a burning taper.

7. Show that phosphorus burnt in air increases in weight.

8. Allow iron borings moistened with sal ammoniac to rust in a confined volume of air and introduce burning taper into residual gas (N).

9. Show that iron filings, suspended by a magnet hanging on one scale of a balance, increase in weight on heating.

10. Strongly heat the red substance which may be formed by gently heating mercury in the air. Collect and test the gas (O) with a glowing splinter of wood.

11. Add the gas thus obtained to the residue obtained in experiment 4 or 8 so as to make up the original volume of air, and show that a taper burns in this mixture as in common air.

12. Refer to numbers giving exact analysis of air, calling especial attention to the fact that it varies slightly in composition.

Also explain that no obvious change, such as increase of temperature or alteration of bulk, occurs when oxygen and nitrogen are mixed. Also that air has the properties of a mixture, and that when water is shaken up with air a portion of that air dissolves, the residue being found to contain relatively less oxygen than the original air, whilst the dissolved portion contains relatively more oxygen, and that this could not be the case if the air were a compound. Consequently it is a mixture and not a chemical compound.

13. It is important that these experiments should be made and their explanation given so as to teach the student how the composition of air is ascertained by experiment, and in a similar manner how oxygen was discovered by Priestley, and how the composition of the air and the part which oxygen plays in the phenomena of combustion were experimentally demonstrated by Lavoisier.

III.—*Effects of Animal and Vegetable Life upon the Atmosphere*

1. Show that by drawing air into the lungs through lime-water a very faint, if any, precipitate is produced; but that on expiring air from the lungs through another portion of lime-water a copious precipitate is soon formed.

2. Show the production of carbon dioxide by the oxidation of ordinary articles of food, as by heating small quantities of the dried substance, such as sugar, bread, or meat, with copper oxide.

3. Show that carbon dioxide exists in the air by pouring clear lime-water into a shallow vessel exposed to air, and explain that this small quantity of carbon dioxide serves as the main food of the plants that grow on the earth.

4. Expel air from water by boiling, and explain how fish and aquatic plants are thus provided with oxygen and carbonic acid.

5. Explain that plants eliminate and animals require oxygen. That animals take in oxygen from the air, and give out carbonic acid. That plants possess the power under the influence of light of assimilating carbon from carbon dioxide and liberating the oxygen. Explain that thus the balance of oxygen and carbon dioxide in the atmosphere is maintained.

6. Illustrate the action of plants by the formation of bubbles of oxygen when a fresh plant is exposed to the action of light in water containing carbonic acid in solution.

IV.—*Water*

1. Illustrate the three states of matter, the solid, the liquid, and the gaseous, with ice, water, and steam, and point out that the difference is caused by increase or diminution in the amount of heat present.

2. Composition of water. Decompose water by the electric current. Collect the two gases separately in a voltameter, and exhibit their properties.

3. Show formation of water by explosion of a mixture of hydrogen (two volumes) and oxygen (one volume) in a soda-water bottle.

4. Explode soap-bubbles inflated by a mixture of hydrogen and oxygen in the above proportions.

5. Throw potassium or sodium into water, and collect the hydrogen.

6. Pass steam over red-hot iron, collect the gas and show that it is hydrogen.

7. Show that the same gas may be obtained by dissolving zinc clippings or iron turnings in dilute sulphuric acid.

8. Demonstrate the properties of hydrogen :
(*a*) Its combustibility.
(*b*) Its lightness.
(*c*) That a candle will not burn in it.
(*d*) That water is formed when it burns in air.

9. Composition of water. Pass oxygen over red-hot copper, and show by weighing before and after that the weight increases.

10. Pass hydrogen over the copper oxide thus produced, heating gently. Collect the water, and show that the copper oxide has been entirely reduced, the tube weighing the same as before passing the oxygen through it.

11. Determine the composition of water by weight by passing dry hydrogen over half an ounce of copper oxide, and collecting the water in a weighed chloride of calcium tube. Show approximately that water contains two parts by weight of hydrogen to sixteen parts by weight of oxygen.

12. Note the first law of chemical combination : that chemical compounds, such as water, always contain their components in the same unvarying proportions.

13. Contrast the properties of water with those of its constituents on the one hand, and the properties of air with those of its constituents on the other.

14. Call attention to air and water as illustrations of the difference between a mixture and a compound, and quote oxygen, nitrogen, and hydrogen as examples of elementary bodies.

15. Separation of impurities from water by filtration and distillation. Preparation of fresh water from salt water.

16. Experiments illustrating solution and crystallisation. Soluble substances, as sugar, washing soda, alum; slightly soluble substances, as gypsum or plaster of Paris ; insoluble substances, as chalk, flint, and sand.

17. Crystallise carbonate of soda, and sulphate of copper.

V.—*Oxygen and Ozone*

1. Prepare oxygen by heating
(*a*) Oxide of mercury.
(*b*) Potassium chlorate.
(*c*) Mixture of potassium chlorate, and either manganese dioxide, copper oxide, or ferric oxide.

2. Show the re-ignition of a splinter of red-hot wood and glowing wick of taper.

3. Burn charcoal in oxygen, and show the formation of carbon dioxide.

4. Burn phosphorus simultaneously in air and in oxygen.

5. Burn watch-spring in oxygen.

6. Show that iron does not rust in dry oxygen.

7. *Ozone.*—Describe and demonstrate the formation of ozone by submitting oxygen to the silent electric discharge.

8. Describe and demonstrate the properties of ozone which distinguish it from ordinary oxygen, such as its action on metallic mercury, on indigo solution, or on potassium iodide and starch. Also its change to ordinary oxygen when passed through a heated glass tube.

9. Explain the difference in density between oxygen and ozone.

VI.—*Combining Weights ; Names and Symbols of the Elements ; Chemical Calculations, &c.*

1. Exhibit list of the elements, distinguishing (by means of the type) the non-metals from the metals ; and, again, the more commonly occurring metals from those which are rarer.

2. Describe the occurrence of these elements in the air, in the sea, and in the solid crust of the earth.

3. Write up the results of the quantitative analysis of potassium chlorate. Explain that this is the result of experiment, and demonstrate the fact that, when heated, an unalterable weight of oxygen is given off and a given unalterable weight of potassium chloride remains behind.

4. Dissolve a crystal of pure chlorate of potassium, and the residue of chloride from heating chlorate, in two separate glasses, and show the difference in the reaction with silver chloride.

5. Explain the meaning of the term chemical symbol, and chemical formula of the salt, referring afterwards to the combining weights of the elements.

6. Explain the mode of determining the formula from the percentage composition.

7. Method of calculating the quantity of oxygen from potassium chlorate (and from manganese dioxide).

VII.—*Acids, Bases, and Salts*

1. Burn sodium in oxygen ; dissolve the product in water ; give the formula of the oxide. Express the action of water upon it by an equation.

2. Act on water with sodium, and collect the hydrogen. Explain by equation that the same substance, sodium hydrate or hydroxide, or caustic soda, is formed, as in experiment 1.

3. Burn sulphur in a current of oxygen, and show the product fumes slightly in the air. Explain that it is a mixture of sulphur dioxide and trioxide. Pass the gas thus obtained into water.

4. Add litmus solution to the solutions obtained in experiments 2 and 3, and show that on adding the one solution to the other the colour is changed, or a point is reached where a further addition of the one has no effect, whereas a minute addition of the other at once changes the colour. Explain the action by an equation.

5. Explain that the compound formed from the sodium oxide and water is termed an alkali, or alkaline or basic hydroxide, and the oxide from which it is formed an alkaline or basic oxide ; that the compound formed from the sulphur dioxide and water is termed an acid hydroxide or acid, and the original oxide an acid forming oxide or anhydride.

6. Explain that sodium hydroxide and sulphurous acid may be taken as representative of the two classes into which hydroxides are divided.

7. Explain that by the action of the one upon the other a salt is formed. Exhibit a white crystalline salt, *e.g.* sodium sulphate.

VIII.—*Hydrogen*

1. Prepare hydrogen by the action of dilute sulphuric acid on zinc.

2. Show that it is not obtained by the use of pure zinc (amalgamated zinc is best used), and illustrate the effect of impurity by adding a drop or two of a lead or copper salt.

3. Prepare hydrogen by dissolving zinc or aluminium in sodium hydroxide.

4. Point out that whereas sodium displaces hydrogen from water at ordinary temperature, and that iron does so at a red heat, copper is without any action at any temperature.

5. Give equations for the various methods here indicated for obtaining hydrogen.

6. Explain fully in detail the methods of chemical calculation, and make the pupils thoroughly understand the methods of calculating quantities.

7. Demonstrate the physical properties of hydrogen, especially its lightness and diffusibility.

8. Compare the heating powers of jet of hydrogen burning in air and in oxygen. Explain the difference.

9. Describe and (if possible) demonstrate the construction and use of the oxy-hydrogen blowpipe.

10. Explain what is meant by heat of combustion, and define the term "heat-unit." Show for this purpose side by side 18 grammes of water and the quantity of water which would be raised 1° C. in temperature by the heat developed in the formation of this quantity of water from its elements.

11. Point out that hydrogen is a powerful reducing agent, illustrating this by the reduction of oxide of iron.

12. Show that nascent hydrogen, or hydrogen at the moment of its liberation from its compounds, frequently produces effects that hydrogen in the free state does not. Bubble hydrogen through ferric chloride solution and show that no discolorisation takes place. Place it in contact with zinc and dilute sulphuric acid and the colour disappears.

13. Explain the term nascent as applied to hydrogen and other gas at the moment of its liberation from one of its compounds, and distinguish between the atom of nascent hydrogen and the molecule of free hydrogen.

IX.—*Hydrochloric Acid and Chlorine*

1. Explain with equation and show the action of sulphuric acid on common salt. Collect the escaping gas by downward displacement and show its solubility in water.

2. Hold piece of paper dipped in ammonia solution in the gas.

3. Saturate water with the gas, noting that its volume increases and that considerable heat is developed.

4. Exhibit the effects produced by adding the solution to litmus and to silver nitrate solution.

5. Show that it has no action on indigo, or on a mixture of potassium iodide and starch solution.

6. Pass the gas over red-hot iron and show the production of hydrogen.

7. *Chlorine.*—Heat oxide of manganese with the solution of hydrochloric acid obtained in experiment 3, and collect several jars of the escaping chlorine by downward displacement. Give the equation.

8. Pass some of the gas into water. Exhibit the yellow colour of the solution and show that it precipitates silver nitrate and bleaches litmus and indigo.

9. Burn a jet of hydrogen in chlorine. Show the disappearance of the yellow-coloured gas.

10. Moisten some paper with a few drops of turpentine and throw it into a jar of chlorine. Point out the formation of hydrochloric acid and the deposition of carbon.

11. Explode a mixture of equal volumes of hydrogen and chlorine.

12. Point out how these experiments show that the gas produced in experiment 1 is a compound of chlorine and hydrogen. Give the symbol and atomic weight of chlorine, and state the composition of hydrochloric acid gas by weight and volume.

13. Explain the production of chlorine from common salt, sulphuric acid, and manganese dioxide. Give equations, and instruct the students in the calculations of quantities.

14. Show the combustion in chlorine, of phosphorus, antimony, and copper, and demonstrate its power to displace bromine and iodine from their compounds with metals.

15. Electrolysis of hydrochloric acid solution, and explain the fact of the evolution of equal volumes of its constituent gases.

16. Explain the bleaching action of chlorine as being due to the readiness with which it combines with hydrogen and that it thus acts as an oxidising agent. In illustration of this, show that a piece of dry turkey red cloth when placed in dry chlorine is not bleached.

X.—*Nitrogen and Ammonia*

1. The production of nitrogen from the air and the examination of its properties may here be repeated.

2. Describe and (if possible) demonstrate the production of ammonia by passing sparks from an induction coil or electric machine through a mixture of nitrogen and hydrogen. Explain that the reaction is not complete unless the ammonia is withdrawn as it is formed, owing to the fact that ammonia is readily decomposed by heat.

3. Prepare ammonia by heating an ammoniacal salt with slaked lime. Collect by upward displacement and over mercury, and show extreme solubility in water.

4. Demonstrate and explain its combination with hydrochloric acid, and show the volatility of sal ammoniac.

5. Show that the aqueous solution of ammonia behaves in the same way as a solution of sodium hydroxide, turning red litmus blue, neutralising acids, and forming precipitates in solutions of metals (copper, iron, and zinc salts, for example) of the same composition as those produced by sodium hydroxide. Explain that on this account it is considered that the ammonia solution contains ammonium hydroxide.

6. Pass dry ammonia gas over red-hot copper oxide and show the production of water and metallic copper.

7. Pass air and ammonia gas simultaneously over red-hot copper as a method of preparing nitrogen.

XI.—*Nitric Acid and the Oxides of Nitrogen*

1. Explain on the blackboard the composition by weight of the five distinct oxides of nitrogen as illustrative of the law of chemical combination in multiple proportions, and as a deduction from this, explain Dalton's atomic theory and state clearly what is meant by an atom. Demonstrate with a series of blocks labelled with the symbols of the different elements how this explains the observed facts of combination in multiple proportions.

2. Make clear to the student the difference between atom and molecule, and explain atomic weight and molecular weight of (1) hydrogen; (2) oxygen, ozone; (3) chlorine; and then of compounds such as (4) hydrochloric acid; (5) water; (6) ammonia.

3. Describe and (if possible) demonstrate the formation of the red fumes of nitric peroxide on passing an electric spark through air.

4. Preparation of nitric acid from nitre and sulphuric acid. Explain the reaction by an equation.

5. Calculation of quantities to be carefully gone into.

6. Exhibit nitre, nitrate of soda, sulphate and bisulphate of potash, and sulphate and bisulphate of soda.

7. Show the oxidising action of nitric acid by dropping it on to some red-hot charcoal.

8. Oxidising action of nitric acid on metallic tin and metallic copper.

8A. Deflagrate mixture of nitre and charcoal.

9. Show the decomposition of nitric acid when heated by dropping it into the bowl of a clay tobacco pipe, the stem of which is strongly heated, collecting the gas over water and testing with a flaming splinter of wood.

10. Heat potassium nitrate and collect the gas (O).

11. Prepare nitric oxide from residue in experiment 10 by treating with dilute sulphuric acid. Explain decomposition o nitrous acid into nitric oxide and nitric acid.

12. Prepare nitric oxide by action of nitric acid on copper turnings. Collect the gas. Explain the reaction.

13. Exhibit the direct combination of nitric oxide with oxygen. Note the formation of red fumes of nitrogen peroxide and their immediate absorption by water.

14. Show that flame of a taper is extinguished in nitric oxide, and that feebly burning phosphorus is also extinguished, but that brightly burning phosphorus continues to burn, and with greater brilliance than in ordinary air. Explain this.

15. Preparation of nitrous oxide. Neutralise nitric acid with ammonia. Evaporate the solution and obtain the solid salt. Show the preparation of nitrous oxide with this residue. Collect the gas over warm water. Give equation. Explain that nitrous oxide is readily soluble in cold water.

16. Show that like oxygen, nitrous oxide supports the combustion of a taper, and explain that this is caused by the decomposition of the gas, and the union of the constituents of the taper with the oxygen of the nitrous oxide, and liberation of the nitrogen.

17. Also show that phosphorus and strongly ignited sulphur burn in the gas, but that feebly ignited sulphur is extinguished. Explain this.

18. Point out the distinction between nitrous oxide and oxygen: (1) the solubility of nitrous oxide in cold water, (2) the production of nitrogen when bodies burn in it, (3) the fact that nitric oxide does not produce with it red fumes, as is the case with oxygen.

19. Prepare nitrogen from ammonium nitrite (*i.e.* a mixture of potassium nitrite and ammonium chloride).

20. Explain how, in the above experiments, the gradual deoxidation of nitric acid yields the several oxides of nitrogen, and lastly, nitrogen itself.

XII.—*Sulphur*

1. Exhibit the different forms of sulphur: flour of sulphur, brimstone or stick sulphur, and crystallised native sulphur.

2. Dissolve sulphur in bisulphide of carbon, and obtain crystals by spontaneous evaporation. Indicate the identity of this form with the naturally occurring crystals, and its difference from that obtained by fusing sulphur and allowing the mass to cool.

3. Explain what is meant by allotropic modification, and point out how the one form of crystal passes into the other.

4. Show the effect of heat upon sulphur melted in a flask. Contrast the brittle mass derived from cooling the sulphur after heating slightly above its melting-point by pouring into cold water, with the plastic mass obtained when cooled in the same way from a high temperature. Point out the changes which occur as the temperature rises, and exhibit the red vapour of sulphur.

5. Show combustion in sulphur vapour. Insert a coil of copper wire into the sulphur vapour, and show that combination occurs.

6. Distil sulphur in a small retort.

7. Pass hydrogen through boiling sulphur, and demonstrate the formation of hydrogen sulphide by its blackening action on lead paper.

8. Exhibit ferrous sulphide and galena (lead sulphide). Prepare hydrogen sulphide (sulphuretted hydrogen) from the former by the action of dilute sulphuric acid. Collect by displacement and prepare a solution of the gas in water.

9. Show the combustible nature of hydrogen sulphide by burning a jar of the gas, and point out the deposition of sulphur due to incomplete combustion. Demonstrate and explain the decomposition of hydrogen sulphide by chlorine, and show the deposition of sulphur when its solution is allowed to stand exposed to the air and light.

10. Demonstrate the value of hydrogen sulphide as a means of separating the metals into groups, by adding the solution or passing the gas into solutions of the various metals, as, for example, arsenious acid, copper sulphate, lead nitrate, antimony chloride, zinc sulphate, ferrous sulphate, and magnesium sulphate.

Write down the equations in each case.

11. Prepare sulphur dioxide by heating copper with sulphuric acid and collect the gas.

12. Illustrate the condensation of a gas into a liquid by passing sulphur dioxide into a glass tube surrounded by a freezing mixture of ice and salt.

13. Pass the gas into water and demonstrate the acid properties of the solution.

14. Prepare sulphur trioxide from fuming Nordhausen sulphuric acid. Add it to water and compare its behaviour with that of the dioxide under similar circumstances.

15. Describe the formation in the above experiment of sulphuric acid, explain the properties of oil of vitriol, demonstrating its affinity for water as exhibited by the great heat evolved when the two liquids are mixed.

16. Explain the barium chloride test for sulphuric acid.

17. Add barium chloride to a solution of sulphurous acid, and then nitric acid.

18. Explain that in consequence of the readiness with which sulphurous acid takes up oxygen it acts as a bleaching agent and as a powerful reducing agent.

XIII.—*Carbon*

1. Show the presence of carbon (charcoal) in wood by carbonising a splinter of wood in a test-tube; and in white sugar by pouring strong sulphuric acid on to a syrupy solution.

2. Describe the properties and modes of occurrence of the three allotropic modifications of carbon: (*a*) the amorphous form (lamp-black and charcoal), and the two crystalline forms, (*b*) graphite, and (*c*) diamond. Describe the octahedral forms of the crystal of diamond and show glass or wood models.

3. Explain that the same weight of each of these substances when burnt gives the same weight of the same product (carbon dioxide).

4. Calculate the weight of carbon dioxide obtained from a given weight of any one of these forms.

5. Prepare carbon dioxide by treating chalk or carbonate of soda (washing soda) with an acid. Prove that the gas thus obtained really obtains carbon by heating a pellet of potassium in the dry gas contained in a small flask.

6. Demonstrate the high specific gravity of carbon dioxide by pouring it from one vessel to another, and showing that it extinguishes a taper.

7. Pass carbon dioxide over red-hot carbon in an iron tube, and show that it loses a part of its oxygen and is converted into carbon monoxide, a combustible gas, which, on combustion, again yields carbon dioxide. Collect the carbon monoxide over water containing caustic soda, and show that the gas does not render lime-water turbid. Then burn it, and show that the residual gas does possess this power.

8. Pass carbon monoxide over red-hot copper oxide to show the formation of carbon dioxide, and explain the use of carbon monoxide as a reducing agent in metallurgical operations.

9. Explain the changes which take place in an ordinary coal fire. Mention the poisonous nature of the carbon monoxide, and state that it is formed in cases of incomplete combustion from insufficient supply of oxygen.

10. Mention heat of combustion of carbon, and of carbon monoxide, and explain the value of the latter as a fuel.

11. Explain the reaction which takes place when carbon dioxide is passed into caustic soda and into lime-water, and explain the formation of a soluble carbonate in the first, and an insoluble carbonate in the second case.

CHARACTERISTICS OF THE NORTH AMERICAN FLORA[1]

WHEN the British Association, with much painstaking, honours and gratifies the cultivators of science on this side of the ocean by meeting on American soil, it is but seemly that a Corresponding Member for the third of a century should endeavour to manifest his interest in the occasion and to render some service, if he can, to his fellow-naturalists in Section D. I would attempt to do so by pointing out, in a general way, some of the characteristic features of the vegetation of the country which they have come to visit,—a country of "magnificent distances," but of which some vistas may be had by those who can use the facilities which are offered for enjoying them. Even to those who cannot command the time for distant excursions, and to some who may know little or nothing of botany, the sketch which I offer may not be altogether interesting. But I naturally address myself to the botanists of the Association, to those who, having crossed the wide Atlantic, are now invited to proceed westward over an almost equal breadth of land; some, indeed, have already journeyed to the Pacific coast, and have returned; and not a few, it is hoped, may accept the invitation to Philadelphia, where a warm welcome awaits them—warmth of hospitality, rather than of summer temperature, let us hope; but Philadelphia is proverbial for both There opportunities may be afforded for a passing acquaintance with the botany of the Atlantic border of the United States, in company with the botanists of the American Association, who are expected to muster in full force.

What may be asked of me, then, is to portray certain outlines of the vegetation of the United States and the Canadian Dominion, as contrasted with that of Europe; perhaps also to touch upon the causes or anterior conditions to which much of the actual differences between the two floras may be ascribed. For indeed, however interesting or curious the facts of the case may be in themselves, they become far more instructive when we attain to some clear conception of the dependent relation of the present vegetation to a preceding state of things, out of which it has come.

As to the Atlantic border on which we stand, probably the first impression made upon the botanist or other observer coming from Great Britain to New England or Canadian shores, will be the similarity of what he here finds with what he left behind. Among the trees the White Birch and the Chestnut will be identified, if not as exactly the same, yet with only slight differences—differences which may be said to be no more essential or profound than those in accent and intonation between the British

[1] An Address to the Botanists of the British Association for the Advancement of Science; read at Montreal to the Biological Section, August 29, 1884, by Prof. Asa Gray.

speech and that of the "Americans." The differences between the Beeches and Larches of the two countries are a little more accentuated; and still more those of the Hornbeams, Elms, and the nearest resembling Oaks. And so of several other trees. Only as you proceed westward and southward will the differences overpower the similarities, which still are met with.

In the fields and along open roadsides the likeness seems to be greater. But much of this likeness is the unconscious work of man, rather than of Nature, the reason of which is not far to seek. This was a region of forest, upon which the aborigines, although they here and there opened patches of land for cultivation, had made no permanent encroachment. Not very much of the herbaceous or other low undergrowth of this forest could bear exposure to the fervid summer's sun; and the change was too abrupt for adaptive modification. The plains and prairies of the great Mississippi Valley were then too remote for their vegetation to compete for the vacancy which was made here when forest was changed to grain-fields and then to meadow and pasture. And so the vacancy came to be filled in a notable measure by agrestial plants from Europe, the seeds of which came in seed-grain, in the coats and fleece and in the imported fodder of cattle and sheep, and in the various but not always apparent ways in which agricultural and commercial people unwittingly convey the plants and animals of one country to another. So, while an agricultural people displaced the aborigines which the forest sheltered and nourished, the herbs, purposely or accidentally brought with them, took possession of the clearings, and prevailed more or less over the native and rightful heirs to the soil,—not enough to supplant them, indeed, but enough to impart a certain adventitious Old World aspect to the fields and other open grounds, as well as to the precincts of habitations. In spring-time you would have seen the fields of this district yellow with European Buttercups and Dandelions, then whitened with the Ox-eye Daisy, and at midsummer brightened by the cærulean blue of Chicory. I can hardly name any native herbs which *in the fields and at the season* can vie with these intruders in floral show. The common Barberry of the Old World is an early denizen of New England. The tall Mullein, of a wholly alien race, shoots up in every pasture and new clearing, accompanied by the common Thistle, while another imported Thistle, called in the States "the Canada Thistle," has become a veritable nuisance, at which much legislation has been levelled in vain.

According to tradition the wayside Plantain was called by the American Indian "White-Man's foot," from its springing up wherever that foot had been planted. But there is some reason for suspecting that the Indian's ancestors brought it to this continent. Moreover there is another reason for surmising that this long-accepted tradition is factitious. For there was already in the country a native Plantain, so like *Plantago major* that the botanists have only of late distinguished it. (I acknowledge my share in the oversight.) Possibly, although the botanists were at fault, the aborigines may have known the difference. The cows are said to know it. For a brother botanist of long experience tells me that, where the two grow together, cows freely feed upon the undoubtedly native species, and leave the naturalised one untouched.

It has been maintained that the ruderal and agrestial Old World plants and weeds of cultivation displace the indigenous ones of newly-settled countries in virtue of a strength which they have developed through survival in the struggle of ages, under the severe competition incident to their former migrations. And it does seem that most of the pertinacious weeds of the Old World which have been given to us may not be indigenous even to Europe, at least to Western Europe, but belong to campestrine or unwooded regions farther east; and that, following the movements of pastoral and agricultural people, they may have played somewhat the same part in the once forest-clad Western Europe that they have been playing here. But it is unnecessary to build much upon the possibly fallacious idea of increased strength gained by competition. Opportunity may count for more than exceptional vigour; and the cases in which foreign plants have shown such superiority are mainly those in which a forest-destroying people have brought upon newly-bared soil the seeds of an open-ground vegetation.

The one marked exception that I know of, the case of recent and abundant influx of this class of Old World plants into a naturally treeless region, supports the same conclusion. Our associate, Mr. John Ball, has recently called attention to it. The pampas of South-Eastern South America beyond the Rio Colorado, lying between the same parallels of latitude in the south as Montreal and Philadelphia in the north, and with climate and probably soils fit to sustain a varied vegetation, and even a fair proportion of forest, are not only treeless, but excessively poor in their herbaceous flora. The district has had no trees since its comparatively recent elevation from the sea. As Mr. Darwin long ago intimated: "Trees are absent not because they cannot grow and thrive, but because the only country from which they could have been derived—tropical and sub-tropical South America—could not supply species to suit the soil and climate." And as to the herbaceous and frutescent species, to continue the extract from Mr. Ball's instructive paper recently published in the Linnean Society's *Journal*, "in a district raised from the sea during the latest geological period, and bounded on the west by a great mountain-range mainly clothed with an alpine flora requiring the protection of snow in winter, and on the north by a warm temperate region whose flora is mainly of modified sub-tropical origin—the only plants that could occupy the newly-formed region were the comparatively few which, though developed under very different conditions, were sufficiently tolerant of change to adapt themselves to the new environment. The flora is poor, not because the land cannot support a richer one, but because the only regions from which a large population could be derived are inhabited by races unfit for emigration."

Singularly enough, this deficiency of herbaceous plants is being supplied from Europe, and the in-comers are spreading with great rapidity; for lack of other forest material even apple-trees are running wild and forming extensive groves. Men and cattle are, as usual, the agents of dissemination. But colonising plants are filling, in this instance, a vacancy which was left by Nature, while ours was made by man. We may agree with Mr. Ball in the opinion that the rapidity with which the intrusive plants have spread in this part of South America "is to be accounted for, less by any special fitness of the immigrant species, than by the fact that the ground is to a great extent unoccupied."

The principle applies here also; and in general, that it is opportunity rather than specially acquired vigour that has given Old World weeds an advantage may be inferred from the behaviour of our weeds indigenous to the country, the plants of the unwooded districts—prairies or savannas west and south—which, now that the way is open, are coming in one by one into these eastern parts, extending their area continually, and holding their ground quite as pertinaciously as the immigrant denizens. Almost every year gives new examples of the immigration of campestrine western plants into the Eastern States. They are well up to the spirit of the age: they travel by railway. The seeds are transported, some in the coats of cattle and sheep on the way to market, others in the food which supports them on the journey, and many in a way which you might not suspect, until you consider that these great roads run east and west, that the prevalent winds are from the west, that a freight-train left unguarded was not long ago blown on for more than one hundred miles before it could be stopped, not altogether on down grades, and that the bared and mostly unkempt borders of these railways form capital seed-beds and nursery-grounds for such plants.

Returning now from this side-issue, let me advert to another and, I judge, a very pleasant experience which the botanist and the cultivator may have on first visiting the American shores. At almost every step he comes upon old acquaintances, upon shrubs and trees and flowering herbs, mostly peculiar to this country, but with which he is familiar in the grounds and gardens of his home. Great Britain is especially hospitable to American trees and shrubs. There those both of the eastern and western sides of our continent flourish side by side. Here they almost wholly refuse such association. But the most familiar and longest-established representatives of our flora (certain western annuals excepted) were drawn from the Atlantic coast. Among them are the Virginia Creeper or Ampelopsis, almost as commonly grown in Europe as here, and which, I think, displays its autumnal crimson as brightly there as along the borders of its native woods where you will everywhere meet with it; the Red and Sugar Maples, which give the notable autumnal glow to our northern woods, but rarely make much show in Europe, perhaps for lack of sharp contrast between summer and autumn; the ornamental Ericaceous shrubs, Kalmias, Azaleas, Rhododendrons, and the like, specially called American plants in England, although all the Rhododendrons of the finer sort are half Asiatic, the hardy American species

having been crossed and recrossed with more elegant but tender Indian species.

As to flowering herbs, somewhat of the delight with which an American first gathers wild Primroses and Cowslips and Foxgloves and Daisies in Europe, may be enjoyed by the European botanist when he comes upon our Trilliums and Sanguinaria, Cypripediums and Dodecatheon, our species of Phlox, Coreopsis, &c., so familiar in his gardens; or when, crossing the continent, he comes upon large tracts of ground yellow with Eschscholtzia or blue with Nemophilas. But with a sentimental difference: in that Primroses, Daisies, and Heaths, like nightingales and larks, are inwrought into our common literature and poetry, whereas our native flowers and birds, if not altogether unsung, have attained at the most to only local celebrity.

Turning now from similarities, and from that which interchange has made familiar, to that which is different or peculiar, I suppose that an observant botanist upon a survey of the Atlantic border of North America (which naturally first and mainly attracts our attention) would be impressed by the comparative wealth of this flora in trees and shrubs. Not so much so in the Canadian Dominion, at least in its eastern part; but even here the difference will be striking enough on comparing Canada with Great Britain.

The Coniferæ native to the British Islands are one Pine, one Juniper, and a Yew; those of Canada proper are four or five Pines, four Firs, a Larch, an Arbor-Vitæ, three Junipers, and a Yew—fourteen or fifteen to three. Of Amentaceous trees and shrubs, Great Britain counts one Oak (in two marked forms), a Beech, a Hazel, a Hornbeam, two Birches, an Alder, a Myrica, eighteen Willows, and two Poplars—twenty-eight species in nine genera, and under four natural orders. In Canada there are at least eight Oaks, a Chestnut, a Beech, two Hazels, two Hornbeams of distinct genera, six Birches, two Alders, about fourteen Willows and five Poplars, also a Plane tree, two Walnuts, and four Hickories; say forty-eight species, in thirteen genera, and belonging to seven natural orders. The comparison may not be altogether fair; for the British flora is exceptionally poor, even for islands so situated. But if we extend it to Scandinavia, so as to have a continental and an equivalent area, the native Coniferæ would be augmented only by one Fir, the Amentaceæ by several more Willows, a Poplar, and one or two more Birches;—no additional orders nor genera.

If we take in the Atlantic United States, east of the Mississippi, and compare this area with Europe, we should find the species and the types increasing as we proceed southward, but about the same numerical proportion would hold.

But more interesting than this numerical preponderance—which is practically confined to the trees and shrubs—will be the extra-European types, which, intermixed with familiar Old World forms, give peculiar features to the North American flora—features discernible in Canada, but more and more prominent as we proceed southward. Still confining our survey to the Atlantic district, that is, without crossing the Mississippi, the following are among the notable points:—

(1) Leguminous trees of peculiar types. Europe abounds in Leguminous shrubs or under-shrubs, mostly of the Genisteous tribe, which is wanting in all North America, but has no Leguminous tree of more pretence than the Cercis and Laburnum. Our Atlantic forest is distinguished by a Cercis of its own, three species of Locust, two of them fine trees, and two Honey Locusts, the beautiful Cladrastis, and the stately Gymnocladus. Only the Cercis has any European relationship. For relatives of the others we must look to the Chino-Japanese region.

(2) The great development of the Ericaceæ (taking the order in its widest sense), along with the absence of the Ericeous tribe, that is, of the Heaths themselves. We possess on this side of the Mississippi 30 genera and not far from 90 species. All Europe has only 17 genera and barely 50 species. We have most of the actual European species, excepting their Rhododendrons and their Heaths,—and even the latter are represented by some scattered patches of Calluna, of which it may be still doubtful whether they are chance introductions or sparse and scanty survivals; and besides we have a wealth of peculiar genera and species. Among them the most notable in an ornamental point of view are the Rhododendrons, Azaleas, Kalmias, Andromedas, and Clethras; in botanical interest, the endemic Monotropeæ, of which there is only one species in Europe, but seven genera in North America, all but one absolutely peculiar; and, in edible as well as botanical interest, the unexampled development and diversification of the genus Vaccinium (along with the allied American type, Gaylussacia) will attract attention. It is interesting to note the rapid falling away of Ericaceæ westward in the valley of the Mississippi as the forest thins out.

(3) The wealth of this flora in Compositæ is a most obvious feature,—one especially prominent at this season of the year, when the open grounds are becoming golden with Solidago, and the earlier of the autumnal Asters are beginning to blossom. The Compositæ form the largest order of Phænogamous plants in all temperate floras of the northern hemisphere, are well up to the average in Europe, but are nowhere so numerous as in North America, where they form an eighth part of the whole. But the contrast between the Compositæ of Europe and Atlantic North America is striking. Europe runs to Thistles, to Inuloideæ, to Anthemideæ, and to Cichoriaceæ. It has very few Asters and only two Solidagoes, no Sunflowers, and hardly anything of that tribe. Our Atlantic flora surpasses all the world in Asters and Solidagoes, as also in Sunflowers and their various allies, is rich in Eupatoriaceæ, of which Europe has extremely few, and is well supplied with Vernoniaceæ and Helenioideæ of which she has none; but is scanty in all the groups that predominate in Europe. I may remark that if our larger and most troublesome genera, such as Solidago and Aster, were treated in our systematic works even in the way that Nyman has treated Hieracium in Europe, the species of these two genera (now numbering 78 and 124 respectively) would be at least doubled.

(4) Perhaps the most interesting contrast between the flora of Europe and that of the eastern border of North America is in the number of generic and even ordinal types here met with which are wholly absent from Europe. Possibly we may distinguish these into two sets of differing history. One will represent a tropical element, more or less transformed, which has probably acquired or been able to hold its position so far north in virtue of our high summer temperature. (In this whole survey the peninsula of Florida is left out of view, regarding its botany as essentially Bahaman and Cuban, with a certain admixture of northern elements.) To the first type I refer such trees and shrubs as Asimina, sole representative of the Anonaceæ out of the tropics, and reaching even to lat. 42°; Chrysobalanus, representing a tropical sub-order; Pinckneya, representing as far north as Georgia the Cinchoneous tribe; the Baccharis of our coast, reaching even to New England; Cyrilla and Cliftonia, the former actually West Indian; Bumelia, representing the tropical order Sapotaceæ; Bignonia and Tecoma of the Bignoniaceæ; Forestiera in Oleaceæ; Persea of the Laurineæ; and finally the Cactaceæ. Among the herbaceous plants of this set I will allude only to some of peculiar orders. Among them I reckon Sarracenia, of which the only extra-North American representative is tropical American, the Melastomaceæ, represented by Rhexia; Passiflora (our species being herbaceous), a few representatives of Loasaceæ and Turneraceæ, also of Hydrophyllaceæ: our two genera of Burmanniaceæ; three genera of Hæmodoraceæ; Tillandsia in Bromeliaceæ; two genera of Pontederiaceæ; two of Commelynaceæ; the outlying Mayaca and Xyris, and three genera of Eriocaulonaceæ. I do not forget that one of our species of Eriocaulon occurs on the west coast of Ireland and in Skye, wonderfully out of place, though on this side of the Atlantic it reaches Newfoundland. It may be a survival in the Old World; but it is more probably of chance introduction.

The other set of extra-European types, characteristic of the Atlantic North American flora, is very notable. According to a view which I have much and for a long while insisted on, it may be said to represent a certain portion of the once rather uniform flora of the Arctic and less boreal zone, from the late Tertiary down to the incoming of the Glacial period, and which, brought down to our lower latitudes by the gradual refrigeration, has been preserved here in Eastern North America and in the corresponding parts of Asia, but was lost to Europe. I need not recapitulate the evidence upon which this now generally accepted doctrine was founded; and to enumerate the plants which testify in its favour would amount to an enumeration of the greater part of the genera or subordinate groups of plants which distinguish our Atlantic flora from that of Europe. The evidence, in brief, is that the plants in question, or their moderately differentiated representatives, still co-exist in the flora of Eastern North America and that of the Chino-

Japanese region, the climates and conditions of which are very similar; and that the fossilised representatives of many of them have been brought to light in the late Tertiary deposits of the Arctic zone wherever explored. In mentioning some of the plants of this category I include the Magnolias, although there are no nearly identical species, but there is a seemingly identical Liriodendron in China, and the Schizandras and Illiciums are divided between the two floras; and I put into the list Menispermum, of which the only other species is Eastern Siberian, and is hardly distinguishable from ours. When you call to mind the series of wholly extra-European types which are identically or approximately represented in the Eastern North American and in the Eastern Asiatic temperate floras, such as Trautvetteria and Hydrastis in Ranunculaceæ; Caulophyllum, Diphylleia, Jeffersonia, and Podophyllum in Berberideæ; Brasenia and Nelumbium in Nymphæaceæ; Stylophorum in Papaveraceæ; Stuartia and Gordonia in Ternstromiaceæ; the equivalent species of Xanthoxylum, the equivalent and identical species of Vitis, and of the poisonous species of Rhus (one, if not both, of which you may meet with in every botanical excursion, and which it will be safer not to handle); the Horse-Chestnuts, here called Buckeyes; the Negundo, a peculiar offshoot of the Maple tribe; when you consider that almost every one of the peculiar Leguminous trees mentioned as characteristic of our flora is represented by a species in China or Manchuria or Japan, and so of some herbaceous Leguminosæ; when you remember that the peculiar small order of which Calycanthus is the principal type has its other representative in the same region; that the species of Philadelphus, of Hydrangea, of Itea, Astilbe, Hamamelis, Diervilla, Triosteum; Mitchella, which carpets the ground under evergreen woods; Chiogenes, creeping over the shaded bogs; Epigæa, choicest woodland flower of early spring; Elliottia; Shortia (the curious history of which I need not rehearse); Styrax of cognate species; Nyssa, the Asiatic representatives of which affect a warmer region; Gelsemium, which, under the name of Jessamine, is the vernal pride of the Southern Atlantic States: Pyrularia and Buckleya, peculiar Santalaceous shrubs; Sassafras and Benzoins of the Laurel family; Planera and Maclura; Pachysandra of the Box tribe; the great development of the Juglandaceæ (of which the sole representative in Europe probably was brought by man into South-Eastern Europe in prehistoric times); our Hemlock-Spruces, Arbor-Vitæ, Chamæcyparis, Taxodium, and Torreya, with their East Asian counterparts, the Roxburghiaceæ, represented by Croomia—and I might much further extend and particularise the enumeration—you will have enough to make it clear that the peculiarities of the one flora are the peculiarities of the other, and that the two are in striking contrast with the flora of Europe.

(*To be continued.*)

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, December 18, 1884.—Sir John Lubbock, Bart., F.R.S., President, in the chair.—The following gentlemen were elected Fellows of the Society:—Liet.-Col. W. R. Lewis, and Messrs. T. B. Blow, H. G. Greenish, A. G. Howard, L. de Niceville, C. B. Plowright, and F. Shrivell.—Mr. H. Ling Roth showed roots of sugar-cane grown in Queensland; the plant appearing to him to possess two sorts, viz. ordinary matted fibrous roots and others of a special kind.—Mr. E. Alf. Heath exhibited a wild cat found dead in a trap in Ben-Armin Deer Forest, Sutherlandshire, where they are still frequently met with.—Mr. W. H. Beeby called attention to examples of burreed (*Sparganium*) obtained at Albury Ponds, Surrey, the plant being quite distinct from the other British species; he proposed for it the name of *S. neglectum.*—In illustration of ornithological notes, Mr. Thos. E. Gunn showed an interesting series in varied plumage of the somewhat rare British bird, the blue-throated warbler. The examples in question were procured by Mr. G. E. Power at Cley, on the Norfolk coast, in September, 1884. Mr. Gunn also exhibited an immature female little bittern, shot at Broxbourne Bridge, Herts, on October 15 in the same year; as likewise a hybrid between a goldfinch and bullfinch, which possessed the marked characteristics of both parents.—Attention was drawn to Mr. R. Morton Middleton's examples of varieties of Indian corn (*Zea mays*, L.) from the United States, Natal, and the borders of the River Danube. The specimens showed marked differences from each other in size, colour, form, and in ornamentation of the seeds.—Mr. Thiselton Dyer exhibited life-size photographs of cones of two species of *Encephalartus* from South Africa, viz. *E. longifolius* and *E. latifrons*, neither hitherto figured in European books. He also showed tubers of *Ullucus tuberosus* from Venezuela, which, though esteemed as an esculent in South America, proved inedible when grown at Kew.—A paper was read by Mr. Henry O. Forbes, on contrivances for insuring self-fertilisation in some tropical orchids. The author described in detail the structural peculiarities of certain Orchidaceæ which had been made the subject of study by him under favourable circumstances. He arrives at the conclusion that a number of orchids are not fertilised by insects, but are so constructed as to enable them to fertilise themselves. This paper was illustrated by diagrams referring more particularly to such forms as *Phajus Blumei*, *Spathoglottis plicata*, *Arundina speciosa*, *Eria javensis*, and others.—Prof. St. G. Mivart read a paper on the cerebral convolutions of the Carnivora and Pinnipedia, and wherein were described for the first time in detail the brains of *Nandinia*, *Galidia*, *Cryptoprocta*, *Bassaricyon* (from a cast of the skull), *Mellivora*, *Galictis*, and *Grisonia*. The author, confirming the views of previous observers, gave additional reasons for a three-fold division of the Carnivora into Cynoidea, Æluroidea, and Arctoidea, though he remarked that amongst the Æluroids the section of Viverrina formed a very distinct group, judged by the cerebral characters. He specially called attention to the universal tendency amongst the Arctoidea to the definition of a distinct and conspicuous lozenge-shaped patch of brain substance defined by the crucial and precrucial sulci. This condition, which he found in no single non-arctoid Carnivora, he also found in the brain of *Otaria Gillespii*, and afterwards in *Phoca vitulina*, where it is very small and much hidden. This fact he adduced as an important argument in favour of the view that the Pinnipedia were evolved from some Arctoid, probably Ursine, form of land Carnivora.—Mr. F. O. Bower read a paper on apospory in ferns. His microscopical investigations on the growth of sporophore generation to the prothallus without the intervention of spores but confirms the statements of Mr. Chas. T. Druery on *Athyrium Filixfœmina*, var. *clarissima*, previously communicated to the Society. Mr. Bower, moreover, finds the case in point to hold good in certain other ferns, for example, *Polystichum angulare*, where there is the formation of an expansion of *undoubted prothalloid nature* bearing sexual organs by a process of purely vegetative outgrowth from the fern plant. That is, there is a transition from the sporophore generation to the oosphore by a vegetable growth, and without any connection either with spores or indeed with sporangia or sori. The author goes on to point out the bearing of these observations and cultures on the general life history of the fern, so far as the modifications of the genetic cycle are concerned; and he further compares this new phenomenon of "apospory" in ferns with similar cases in other plants, while insisting on the importance of the cases at issue.—A communication on the aërial and submerged leaves of *Ranunculus lingua*, L., was read by Mr. Freeman Roper. He shows from specimens obtained near Eastbourne that the two sets of leaves in question differ so materially from each other that they might not be suspected to belong to the same plant, the submerged being larger, broader, ovate or cordate, and possessing abundance of stomata.

Geological Society, December 14, 1884.—W. Carruthers, F.R.S., Vice-President, in the chair.—David Llewellin Evans was elected a Fellow of the Society.—The following communications were read:—On the south-western extension of the Clifton fault, by Prof. C. Lloyd Morgan, F.G.S., Assoc. R.S.M. —On the recent discovery of Pteraspidian fish in the Upper Silurian rocks of North America, by Prof. E. W. Claypole, B.A., B.Sc. Lond., F.G.S.—On some West-Indian phosphate deposits, by George Hughes, F.C.S. (Communicated by W. T. Blanford, LL.D., F.R.S., Sec.G.S.).—Notes on species of *Phyllopora* and *Thamniscus* from the Lower Silurian rocks near Welshpool, Wales, by George Robert Vine (Communicated by Prof. P. Martin Duncan, F.R.S., F.G.S.).

Victoria (Philosophical) Institute, January 5.—A paper on "The Religion of the Aboriginal Tribes of India," by Prof. Avery, was read. In it the author sketched the peculiarities of the beliefs of those tribes, so far as was known.

SYDNEY

Royal Society of New South Wales, November 5, 1884. —H. C. Russell, B.A., F.R.A.S., President, in the chair.—Five

new members were elected and 129 donations received. A paper was read, "Notes on some mineral localities in the northern districts of New South Wales," by D. A. Porter. The following extracts from a letter, dated from Queensland, October 8, to Prof. Liversidge, from Mr. Caldwell, were read:—"Ceratodus has interfered with Platypus. The Platypus eggs were hatched three weeks ago, and I should have been in New England by now, but Ceratodus is much more important. Platypus embryos are quite easy to get. I can't understand how they have not been got before. The fact tha the monotremes are oviparous is the end of the research for many. They don't understand that it is the fact of the egg having a lot of yelk that promises to yield valuable information. Here are some of the principal points in the development of Ceratodus as observed on the whole embryos. I have not attempted to make sections yet; you know what section-cutting is now-a-days. The egg measures about $2\frac{1}{2}$ mm. diameter, and has the protoplasmic pole darker, as in Amphibia. This egg is surrounded by a strong, closely-investing gelatinous membrane about $3\frac{1}{2}$ mm. thick. The segmentation is complete (Holoblastic). Part of the blastopore remains open, and persists as anus. The stages up to hatching closely resemble those of the newt, Amblystoma. After hatching, the larva goes into the mud. It lies on its side like Pleuronectidæ among Teleosteans, and the oldest stages I have reared still show no signs of external gills. The larval changes I expect will continue for many weeks, and I have two plans to save my waiting here, both of which I intend to put into execution at once. First, I shall leave an aquarium with a large number of the larvæ here on a station, where a friend has kindly promised to put a few of the fish in a bottle every day. Second, I shall bring a supply of eggs to Sydney, and attempt to rear them in my laboratory. I hope to get to Sydney in about a fortnight or three weeks' time. I have more than thirty blacks with me now; they have found over 500 Echidna in the last six weeks."—Prof. Liversidge exhibited specimens of sapphires, zircons, the topaz and diamond from the old gold workings near Mittagong, and stated that flints occurred at these mines closely resembling those of the cretaceous formations at home.—Mr. C. S. Wilkinson exhibited specimens of chloride of silver from Silverton, native antimony in calcite, Lucknow, also dendritic gold and arsenical pyrites in massive serpentine.—Mr. Charles Moore announced the discovery of a new species of the giant Australian lily, between the Clarence and Richmond Rivers, and promised some notes upon it at the next meeting.

PARIS

Academy of Sciences, December 29, 1884.—M. Rolland, President, in the chair.—Note on the classification of the moles (genus *Talpa*, L.) of the old world, by M. Alph. Milne-Edwards.—Theorem regarding the complete algebraic polynomes; its application to the rule of Descartes' signs, by M. de Jonquières.—On the integers of total differentials, by M. H. Poincaré.—On the integers of total differentials, and on a class of algebraic surfaces, by M. E. Picard.—On a series analogous to that of Lagrange, by M. Amigues.—Some simple and closely related formulas for the equilibrious pressure of sandy masses or bodies without cohesion, by M. Flamant.—Rectification of the numerical results indicated in a previous communication for the calculation of compressed gas manometers, by M. E. H. Amagat. The rectifications here made are stated by the author in no way to affect his general conclusions.—On seleno-uria and the substances derived from it, by M. A. Verneuil.—On the solubility of the substances comprised in the oxalic series—

$$CO(OH)—(CH^2)^n—CO(OH),$$

by M. Friedel.—On the composition of the seed of the cotton-tree and on the abundance of alimentary substances contained in this grain, by M. Sacc. Writing from Cochabamba under the date of October 25, 1884, the author announces the discovery of a new alimentary substance presenting some most remarkable features in its composition. The accompanying analysis shows that this seed of the cotton-tree, of which several varieties are cultivated in Bolivia, is the richest of all known grains in nitrogenous substances. When milled, it yields the following results:—

Yellow meal	56·50	kilogrammes
Black bran	40·50	"
Waste	3·00	"
	100	"

The writer is convinced that this flour is destined to take an important place in human alimentation, and in the preparation of all kinds of pastes, where it may act as a substitute for milk.—Note on the history of the discovery of the action of the white globules of the blood in inflammatory complaints, by M. A. Horvath. This discovery, hitherto attributed to Cohnheim, is here assigned to Dutrochet, who, so far back as 1824, accurately described the migration of the sanguine globules and their passage into the organic tissues.—Note on the biological evolution of the genus Aphis, and of the allied genera in the family of the Aphidæ, by M. Lichtenstein.—On the discovery of the impression of an insect in the Silurian sandstones of Jurques, Calvados, by M. Ch. Brougniart. The traces are described of the wing of a blattina, to which the author gives the name of *Palæoblattina douvillei*, in honour of M. Douvillé of the Paris School of Mines.—On a crystalliferous vitreous mass resembling obsidian, and evidently derived by igneous action from the schistose rocks of the Commentry coal-measures, by M. Stanislas Meunier.

STOCKHOLM

Royal Academy of Sciences, December 10, 1884.—Prof. Edlund communicated some observations made during the last years confirming his theory on the origin of the electricity of the air, and also of the origin of the aurora borealis and of thunderstorms.—Prof. Nordenskjöld presented a paper on kryokonite from the inland ice of Greenland by himself.—Prof. Ångström gave an account of a report by E. D. Norrman, civil engineer, concerning his observations on ship-building, &c., during a Continental tour undertaken with a grant given by the Academy from the funds of the Litterstedt donations.—Dr. Widman reported on his own researches on a new sort of indigo and on some new derivations of chinolin produced by him from kumminol. The Secretary, Prof. Lindhagen, presented the following papers:—On the passage of the light through isotropical substances, by Prof. Rubenson.—A method to separate chlorine and bromine quantitatively, by Dr. E. Berglund.—On Vortmann's method to determinate chlorine directly, and also the presence of bromine, by the same.—On the intermediate orbit of the comet of Faye in the vicinity of Jupiter in the year 1841, by Dr. Alexander Shdanow of Pulkowa.

CONTENTS

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